$2.35* NZ $2.75 MARCH 1983

eti

ELECTRONICS TODAY INTERNATIONAL

COMPONENT WALLCHART from Jaycar CHECK INSIDE

HOOK UP YOUR APPLE TO THE 'REAL WORLD'

with our general purpose analogue and digital interface for the Apple II

PUSHBUTTON-OPERATED WINDSCREEN WIPER CONTROLLER

SCRs, triacs & power control

'Float' charger for NiCad batteries

Shure V15 Type 5 cartridge reviewed

Power you can taste.

Sony's new TA-AX5 amplifier with memory is a high fidelity feast.

Its multiple memory lets you create your own acoustic "flavours." Bass and treble tone settings, turnover frequencies, high and low filter are all programmable.

At a touch you can instantly recall the recipe for bittersweet country, hot 'n' spicy rock, or a well-seasoned Stravinsky. And electronic displays graphically show you everything the amp is cooking up.

Sony's Audio Signal Processor means that every function is touch controlled. This knifes through the usual maze of audio circuitry for a streamlined design of the future. Pure and simple, it sounds delicious.

TA-AX5

ST-JX4

The ideal companion for this tasty new amplifier is Sony's ST-JX4 synthesizer tuner. Why not make a reservation for two?

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SON 0118

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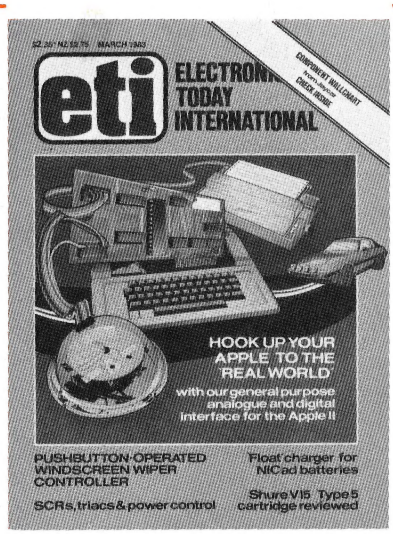


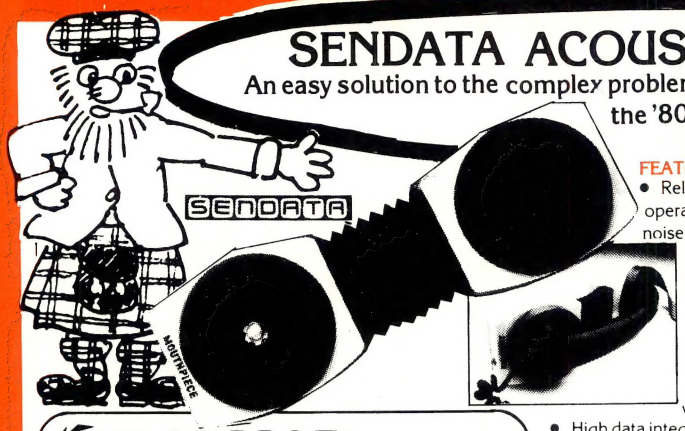
This month's cover features the general purpose interface card for the Apple II, page 36. It shows some of the devices, such as the Tasman Turtle robot and slot car, which can be controlled.

Cover design: by Ali White

Registered by Australia Post — Publication No. NBP0407
ISSN No. 0013-5216

SENDATA ACOUSTIC COUPLER

An easy solution to the complex problem of information gathering in the '80s.



FEATURES
- Reliable 300 BPS Full Duplex operation.
- High degree of ambient noise immunity.
- Power can be supplied from the terminal device or from a 9V plug pack.
- Provide either RS232 or TTL compatible signals.
- 25-way interface cable provided as standard.
- Unique design allows use with most modern handsets.
- High data integrity when both ends are acoustically coupled.

ORIGINATE/ANSWER **$279.93** PLUS TAX CODE Ⓒ

ORIGINATE ONLY **$239.14** PLUS TAX CODE Ⓒ

MEMORY BARGAINS

HM6116P-3	$5.99	250ns
MB2716	$2.95	450ns 16K EPROM
MB2764-30	$10.96	300ns 64K EPROM
MB8118	$3.95	120ns 16384 X 1 RAM
MM2708Q	$2.80	450ns 8K EPROM
MB8114 NLC	$4.00	300ns CERAMIC
HN462532G	$7.00	450ns 32K EPROM
S6834	$13.30	512 x 8 EPROM
S6810	$4.70	128 x 10 RAM 450 NS
MC68000-L8	$99.95	8 MHZ C.P.U.

PLUS TAX CODE C

RALMAR QUALITY AUDIO PRODUCTS

			Tax Code
BULK TAPE ERASER	BTE-1	$30.15	Ⓒ
TAPE MAGNETISER	THD-1A	$19.80	Ⓓ
ELECTRONIC DEMAGNETISER	THD-4	$22.10	Ⓓ
TV TO STEREO ADAPTOR	TVA-1	$11.35	Ⓓ

HEADPHONE EXTENSION 8-METRE CURL CORD FITTED WITH STEREO PLUG & SOCKET $5.65 Ⓓ

6 For The Price Of 5!

6 PACK SPECIALS

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6X74C00	$1.00
6X74C107	$1.50
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6XKBPC602 6A 200V — $5.00

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6X6006L 6A 600V — $4.00

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6XPN2222A — 25c

CAPACITORS

	Normal Price Per Each	Special Price Per Pack of 6
STETTNER 3.12 pf CERAMIC TRIMCAPS	50c	$2.50
ELECTROLYTICS		
2.2Mfd 25V RB's	16c	80c
10Mfd 16V RB's	16c	80c
10Mfd 25V RB's	16c	85c
25Mfd 25V RB's	17c	$1.00
47Mfd 16V	20c	$1.10
47Mfd 25V RB's	22c	$1.00
47Mfd 10V RB's	20c	$1.30
100Mfd 25V RB's	26c	$1.80
100Mfd 25V RB's	36c	
220Mfd 25V RB's		40c
POLYESTERS		
.001Mfd 100V Greencaps	8c	40c
.0047Mfd 100V Greencaps	8c	70c
.01Mfd 100V Greencaps	14c	70c
.012Mfd 100V Greencaps	14c	70c
.022Mfd 100V Greencaps	14c	70c
.033Mfd 100V Greencaps	14c	70c
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.056Mfd 100V Greencaps	14c	70c
.068Mfd 100V Greencaps	14c	70c
.1Mfd 100V Greencaps		$1.00
HARDWARE		
RCA Plugs	20c	$1.75
RCA Chassis sockets	35c	$1.00
3.5mm Plugs mono	20c	$1.75
3.5mm Chassis sockets	35c	
MS102 Push to make switch	35c	$1.75

Ask about our other 6-Pack Specials There's lots more

Model 1260 MICROCOMPUTER SYSTEM DESK

For the first time, a microcomputer system desk with all the features you would look for is available at a HOME COMPUTERIST TYPE PRICE!

$174.69

Inc. tax/20% Ⓑ

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COLOUR CODED FLAT RIBBON

14-Way 98¢ per mtr. 36-Way $2.15 per mtr.
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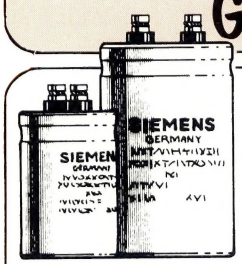
25-Way $1.75 per mtr. 50-Way $3.00 per mtr.

Microphone Cable SC5	40¢ per mtr
75 ohm Co-Ax. Air-Core	50¢ per mtr.
5 Core Shielded	$1.40 per mtr.
Fig. 8 Shielded	40¢ per mtr.
2 x Fig. 8 Shielded	80¢ per mtr.
2 Core Shielded SC6	60¢ per mtr.
5 Core Unshielded MC7-5	40¢ per mtr.
8 Core Unshielded MC7-8	95¢ per mtr.

MANY MORE TYPES AVAILABLE. ALL CABLES TAX CODE Ⓒ

Great Value!



COMPUTER GRADE ELECTROLYTIC CAPACITORS

47,000 µf 16 VOLT	$8.20
100,000 µf 16 VOLT	$14 31
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47,000 µf 25 VOLT	$10 70
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PLUS TAX CODE Ⓒ

SELF CLEANING SCOPE Desoldering Tool MODEL SR

- Metal crush proof body.
- Replaceable nozzle — slim profile f high density PCB's.
- Self cleaning — plunger extensi ejects solder particles.
- Replaceable plunger washer

$15.50 + B tax

MONEY SAVERS! FERGUSON TRANSFORMERS

PL15/5VA	$5.85	PL18/40VA	$12.15
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PL30/20VA	$10.80	PL24/60VA	$15.75
PL12/20VA	$10.80 —		

PLUS TAX CODE Ⓒ

NIBBLING TOOL

CUTS holes any shape, any size over 7/16".
TRIMS undersized holes to fit parts.
NOTCHES clearance for plugs and wiring.

$14.60 + B tax.

SUPERSCOPE PROFESSIONAL SOLDERING IRON

Adjustable power and heat.
20 – 140 Watts
Fast heating 200°C – 500°C.

Model SSB **$24.00** + 'B' tax

SCOPE MINI SUPER SPEED SOLDERING IRON.

Variable temperature
10-75 WATTS.
5 second heating.
3.3 to 6 VOLT operation

Model MSB **$26.60** + B tax.

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SEAL OF SATISFACTION MAGRATHS WORLD OF ELECTRONICS

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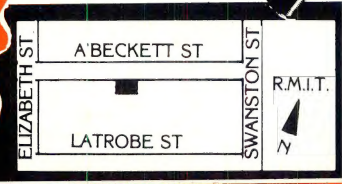
Ⓐ – EXEMPT Ⓒ – 20%
Ⓑ – 7.5% Ⓓ – 32.5%



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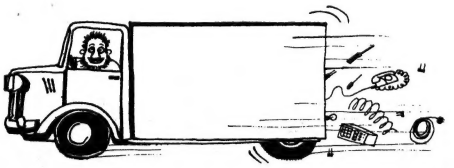

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next month

BUILD A ROBOT ARM!

Last year we brought you the Tasman Turtle robot — this year, it's the Micro-Grasp robot arm! The next logical step (pardon the pun . . .) for hobby computerists is robotics. Next month's feature project is a robot arm that is jointed at the shoulder, elbow and wrist and includes a gripper. It can be interfaced to most computers. GET and PUT commands will never be the same again!

THE WORLD OF SCANNING

There's a whole other world of communications beyond 'the shortwaves'. There are thousands of communications channels in the very high and ultra high frequency bands (VHF and UHF). Aircraft, carphones, customs, taxis etc. What's it all about? This article explains it in straightforward terms and looks at some of the equipment available for exploring the world beyond the shortwaves.

RTTY CONVERTER FOR THE MICROBEE

This simple project allows you to hook up the MicroBee to a receiver and print radioteletype messages on the VDU screen. A simple bit of software (included in the article) does the decoding.

HOW TO USE DVM MODULES

Part 1 of a two-part series giving dozens of applications and circuits for the popular liquid crystal display digital voltmeter modules like the DPM-05 and ETI-161 (from Aug. '82). Circuits include: ratiometric measurement techniques, thermometers, ohmmeters, voltmeters of all varieties, capacitance meters, frequency meters, etc.

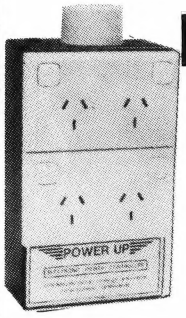
LIGHTWEIGHT HEADPHONES REVIEWED

Lightweight headphones are in big demand — especially for use with 'hip' stereo players and receivers. Louis Challis has reviewed seven models from the well-known European and Japanese manufacturers — and makes some interesting observations.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

POWER CONTROL KITS

See EA November, 1982



POWER UP

A MUST FOR YOUR COMPUTER SYSTEM

This great new Project from EA is the answer to a Maidens Prayer.

What Does it Do?

A single 240v mains plug and lead feeds one unswitched master 240v outlet plus 4 switched 240v outlets. **With say a hi-fi system,** plug your main equipment item (e.g. Amp) into the master outlet and whenever you "switch on" your amp — presto — mains power is applied to the other 4 outlets i.e. simply "turning on" your amp turns on your tape cassette, tuner, turntable, graphic equaliser without mains spikes, plops etc.

Just the shot for your Computer System. The Altronics Kit includes case and all outlets.

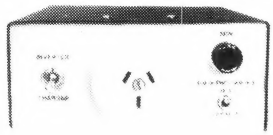
Cat K6000 . . . . . $39.50

GO ANYWHERE 240V PWR. KITS

See EA May and June 82. These great new inverter kits enable you to power 240V appliances for your car, caravan or boat. (From Standard 12V car battery.)

40 WATT

Suits small appliances, i.e. turntable, tape deck, shaver etc. Variable frequency adjustment enables accurate speed control of turntable motors.



IC Sockets Provided

K6700 . . . . . $55.00

300 WATT

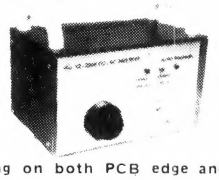
Fully regulated and overload protected XTAL locked frequency.

★ ★ ★ ★ ★

NOW USING HIGH EFFICIENCY TRANSFORMER

★ ★ ★ ★ ★

Use to power hi-fi, TV sets and for emergency lighting.



- **Gold plating on both PCB edge and edge connector.**
- **Low age rate parallel resonant XTAL used.**
- **Sockets for all IC's.**

K6750 . . . . . $199.50

$10 DELIVERY ANYWHERE IN AUSTRALIA!

NEW UNIVERSAL DC-DC INVERTER

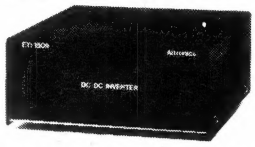
SEE ETI MAG. SEPT. 1982

Rated at 200 watts this versatile inverter can be simply configured for virtually any desired input/output voltage required by the winding format of T2.

Typical input voltages: 12/24/32 V. **Typical output voltages available:** ± 50, ± 15, ± 40, 1400 V.

Now you can use high power hi-fi and PA amps for your boat, caravan etc.

K 6509 includes metal case **$39.50**



40W FLUORESCENT LIGHT INVERTER FOR 12V BATTERY OPERATION

Self-oscillating, push-pull inverter operates above the audible frequency range and is capable of driving two 20 watt or one 40 watt fluorescent tube to 150% of normal (240 volt operation) efficiency.

Great for camping, working on the car, and of course, during power blackouts!

Complete boxed kit, including all winding wire.

K 6505 Includes Metal Case **$37.50**

ELECTRONIC FLOURO STARTER

(SEE EA OCT. 1982)

Save a fortune on Flouro Tubes.

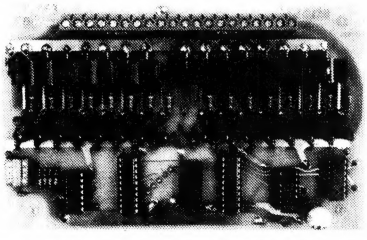
- ★ Extends the life of your flouro tubes by 1,000's of hours.
- ★ Instant "ON" — no more flickering at switch on.

K6300 . . . . . **$4.95**

COMPUTER KITS

16 CHANNEL COMPUTER OUTPUT DRIVER

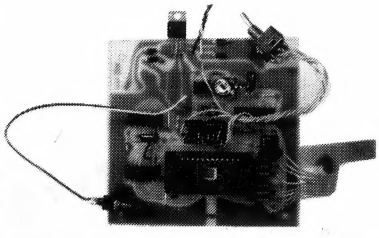
(SEE ETI NOV. 1982)



Drive Relays, Motors, Solenoids etc under software control. Do something useful with your computer: Like cook toast, control the hot water system, control anything that your imagination can think of. Altronics supply ★ TIP31B's not BD139's ★ IC Sockets ★ DIP Headers Provided ★ 1 full meter of rainbow cable. Two independent groups of 8 outputs are provided. Each can be configured to sink 3, 2 or 1 Amps from a 12v supply. All components mount on 1 double sided PCB for ease of construction.

K9653 . . . . . **$44.50**

'MICROBEE' EPROM PROGRAMMER



VERSATILE, LOW COST & EASY TO BUILD

Great new project from ETI (Jan. 1983). All components mount on a single printed circuit board. Unit simply plugs into the Microbee 1/0 port. Suitable for 2716, 2732, 2532, 2732A and 2764's. Burn your games programmes and eliminate cassette loading times ★ Zero insertion force IC socket for eproms ★ Sockets for all other IC ★ 1 x 2716 supplied — get started straight away. ★ Kit supplied in deluxe jiffy box, all mounting hardware included

K9668 **$48.50**

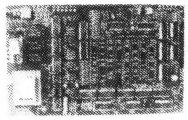
VIDEO RF MODULATOR

(SEE ETI OCT. 1981)

If you cannot afford a Video Monitor for your computer this is the kit for you. Super stable oscillator design and very low modulation distortion ★ Works with both B & W and Colour TV sets ★ Suitable for computers, TV games, TV pattern generators or what have you. Deluxe kit featuring heavy duty diecast box for RF shielding ★ Input and output sockets.

K9760 **$17.50**

ETI'S BRILLIANT NEW DIRECT-CONNECT COMPUTER MODEM



Employs unique 'Commutated Filter' design overcoming virtually all the problems involved with conventional modems.

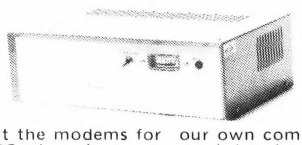
Super flexible unit facilitates communications between computers over cables, the telephone network and radio links.

Unit connects to a standard RS 232 interface and is capable of both 1200/75 Baud and 300/300 Baud transmission and reception ★ Line switching; answer and dialing facilities on board.

EXCLUSIVES: ★ Plated through, double sided PCB ★ Complete set of IC sockets ★ Kit requires 85 IN914 Diodes for programming these are included ★ Ceralock resonator and matching balanced load capacitor used for long life and high accuracy ★ Telecom approved isolating transformer and Reed relays included.

K 9644 . . . . . (See ETI Oct 82) **$169.50**

MODEM MONITOR AND CASE OPTION I



Having built the modems for our own computer use ALTRONICS strongly recommend (as do ETI) the inclusion of Audio and Visual Monitoring (signal strength). Our K 9645 includes all the components listed on Page 23 October ETI, custom ALTRONICS PCB, speaker, panel meter, front panel and case to house these options plus the full modem.

K 9645 Modem Option I. . . . . **ONLY $30.00**

EA DRILL SPEED CONTROLLER MK II

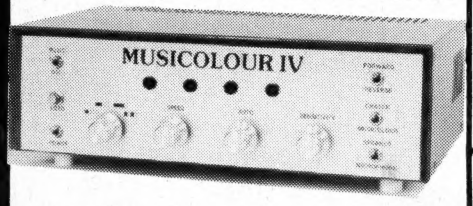
For Universal Brush Type Motors Drawing up to 3 amps.

Varies motor speed from a few RPM to full speed while maintaining good torque. Suitable for:— Drills and Drill Presses; Circular Saws; Jig Saws; Food Mixers; Movie Projectors.

ALTRONICS Kit is complete with mains flex and plug and is supplied with Jiffy Box and solid steel front panel.

K 6005 . . . . . **VALUE $13.95**

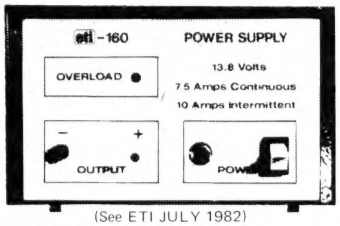
THE EVER POPULAR MUSICOLOUR IV EA PROJECT



Combination Colour Organ and Light Chaser. Four channel colour organ. Internal microphone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned.) Four chaser modes forward **and** reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc.

K5800. . . . . **$89.50**

13.8V HIGH CURRENT SUPPLY



(See ETI JULY 1982)

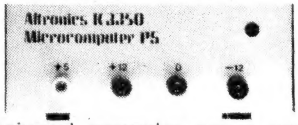
- Output voltage — 13.8 Vdc.
- Output current — 7.5A continuous, 10A intermittent
- Regulation — 0 to 7.5A : 50MV

Save the expense of a mains powered rig. Kit complete in every way.

K3250. . . . . **$84.00**

ALTRONICS K 3350 MICROCOMPUTER POWER SUPPLY

+ 5 Volts @ 3 Amps, + 12 Volts @ 2 Amps, — 12 Volts @ 200 mA



This universal computer power supply is based upon an EA design. (Our version is uprated).

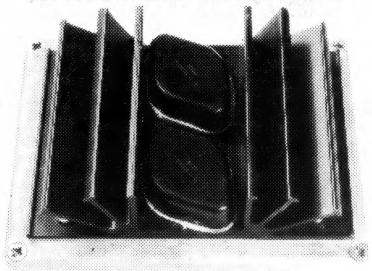
+ 5 Volts for memory, CPU all Micro's.
+ 12 Volts for RS232 interfaces etc.
— 12 Volts handy for additional hardware using OP Amps.

★ Uses TO-3 Regulators + 5 V and + 12 V.
★ Heavy Duty Fan Type Heatsink.
★ Complete Boxed Kit with Delux Front Panel.

NOTE: This unit has enough grunt to power most small disk drives.

K 3350 **$59.50**

TRANSISTOR ASSISTED IGNITION WITH DWELL EXTENSION



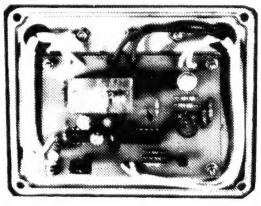
The Altronics Kit includes all components for the modifications, detailed by Electronics Australia Feb. 1983.

Yes, it's bad enough paying $2.00 a gallon for petrol without wasting a fortune on an out of tune engine. Fit this transistor assisted ignition kit in minutes and start saving money from the very next petrol stop. Easy to build!

K 4010 . . . . . **$35.00**

CURRENT TRIP CAR ALARM

Exit / entry delay
No false alarms
State of the Art Design by ETI

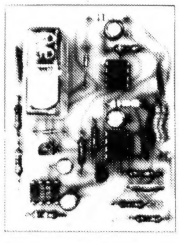


Protect Your Valuable Car and Contents

Circuit detects minutest voltage drop across vehicle's battery earth strap, tripping the alarm ★ uses Milspec LM394 ★ Quality diecast box ★ genuine fujitsu relay ★ automatic reset after pre set time period ★ installs in minutes ★ includes dash mounting LED-flashes to deter thieves.

K 4330 . . . . . **$29.50**

CAR ALARM ETI 084



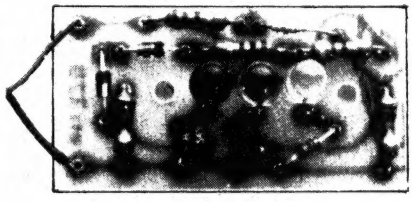
A staggering number of cars are stolen each year. Install an Altronics Alarm Kit and yours won't be one of them.

Circuit operates by detection of voltage drops in the electrical system and features a flashing LED for dash mounting as a deterrent to would be vandals and thieves.

K 4084 . . . . . **$12.00**

BATTERY CONDITION INDICATOR

Ingeniously simple circuit indicates battery low-okay-overcharging, ETI Kit

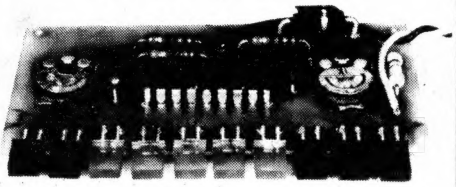


An Investment Against the Cost of a New Battery

K4320. . . . . **$4.95**

EXPANDED–SCALE LED VOLTMETER

HAS MANY APPLICATIONS



ETI design suitable for lead-acid wet cells, lead acid gel electrolyte, vented nickel cadmium types and so on and so on.

Unit covers range of 10.5v to 15v

Determine battery condition instantly

Easy to Build!

K4326. . . . . **$9.50**

ETI "AUTO TESTER"

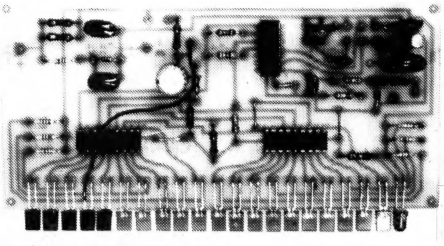
Handy little test gadget will enable you to check voltage drops, on/off battery charge voltages and resistances in any vehicle electric systems.

Unit indicates: reversed polarity ★ voltage drops of 0.5Vor less ★ voltage between 12V and 13.5V ★ voltages above 13.5V ★ resistance below 150R ★ resistance 10K or above ★ resistance 50K or above.

Polarity and Overvoltage Protection Complete Boxed Kit

K4334. . . . . **$14.50**

TWIN RANGE LED TACHO (see ETI Aug 1980)



Unit suitable for 1, 2, 3, 4, 6 and 8 cylinder vehicles, 2 stroke or 4 stroke ★ fully compatible with conventional, CDI and transistorized ignition systems ★ includes protection circuitry to prevent noise and high voltage spikes from the points and coil circuit damaging the electronics. ★

Display flashes when over-reving occurs ★ only 3 connections required to electrical system.

Check The Performance of Your Vehicle At A Glance!

K 4324 . . . . . **$24.50**

ALTRONICS

For address, phone number and despatch details see our advertisement on page 45.

Australian laser is really hot stuff

The brightest laser in the world can be found at the Australian National University. The laser research group, within the Research School of Physical Sciences, is using the laser for probing the behaviour of matter under extremely hot and energetic conditions.

The laser can deliver radiation of unparalleled intensity to a target, vaporising it, stripping electrons from atoms, transforming it instantly to a superhot cloud of ionised atoms and free electrons known as plasma.

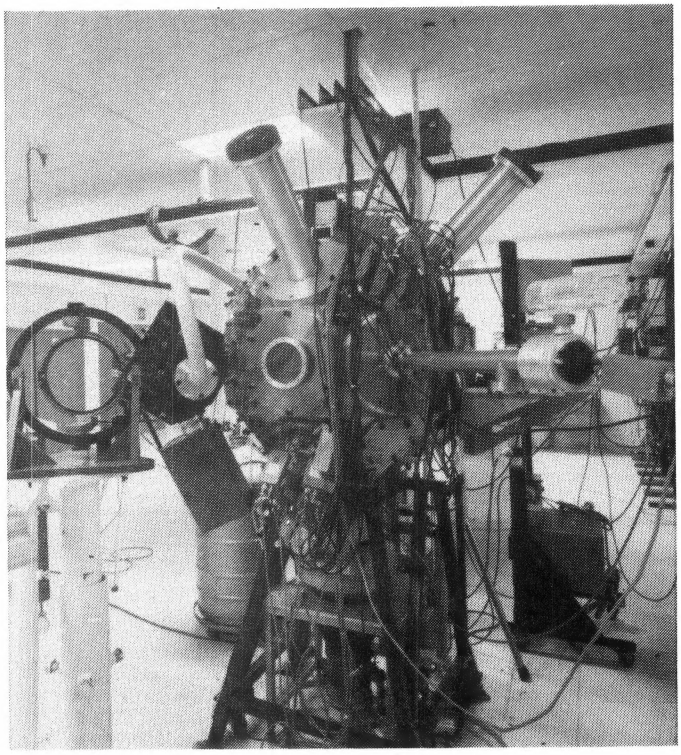
When laser light was first produced from a ruby crystal about 20 years ago no one was quite sure how to make the best use of it. Laser light has some unique characteristics, including extreme purity of colour and the property known as 'coherence', which means, among other things, that a beam of laser light is precisely aligned. It doesn't spread out and can be focussed down to a very fine point.

At the ANU the laser light (actually infra-red radiation) is produced by rods of silicate glass doped with the rare element neodymium. When the beam is focussed through a high quality lens system it forms a spot with a diameter of only two microns and a power density of more than 10^{18} watts/sq cm. This is comparable to all the sunlight falling on the earth's surface being funnelled onto one square centimetre.

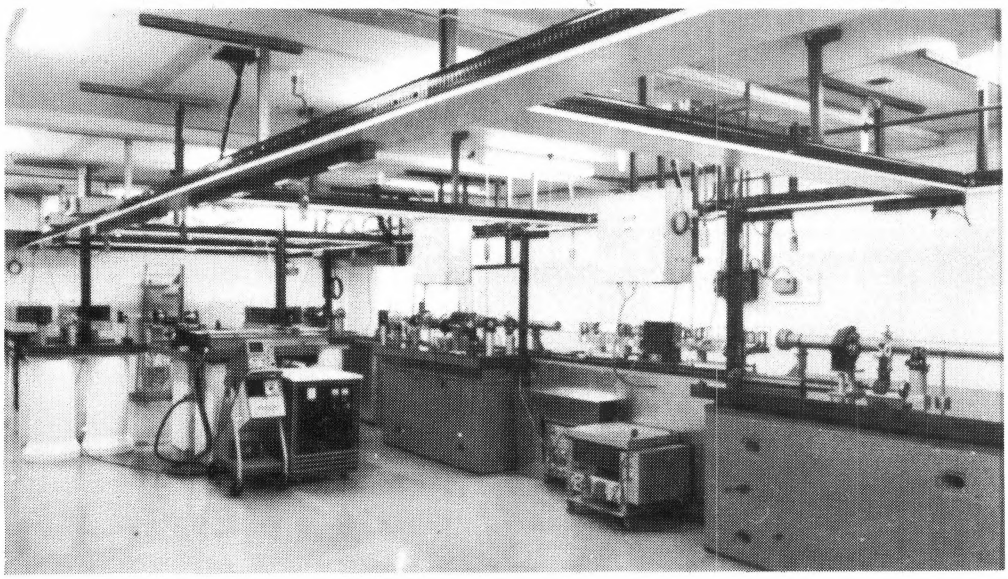
The laser research group, which is part of the Department of Engineering Physics, has been studying the behaviour of high temperature plasmas. At very high intensities the stream of photons in the laser beam exerts a pressure on the plasma, stretching it out of shape. The ANU team has taken holograms which show the remarkable effects of 'light pressure'.

The fact that the hot though very shortlived plasma emits x-rays leads to the possibility of studying very fast chemical reactions by irradiating the reacting chemicals with the very short pulses of x-rays. The ANU team is currently engaged in a joint study of this method with chemists from the University of Sydney.

The next step for the laser group will be the substitution of phosphate glass for the silicate glass now used in the laser. This would produce a laser with a power density of about two and a half times what they are achieving at present, with the possibility of transforming the energy of the plasma into matter through 'pair-production'. So there's more excitement to come.



Chamber pot. Target chamber for studying plasma reactions.



Hot shot! Overview of the ANU's powerful infra-red laser system.

High-res contact film

Allmakes Micrographics, suppliers of duplicating films for the micrographics industry, has introduced to their line of products a complete range of Teledyne Post's new Ultra-Fi non-silver diazo duplicating film.

Ultra-Fi is a high resolution diazo contact film for use in graphic arts, litho duplicating and ideally suited for printed circuit photo tooling. Because Ultra-Fi is an organic dye based emulsion rather than the usual silver emulsion, the film can be for all practical purposes considered grainless, giving extremely high resolution in the order of 500 lines/mm.

Ultra-Fi has a tough, scratch resistant surface on a polyester base which is available in a range of thicknesses. Unexposed Ultra-Fi can be safely handled in normal room lighting so a darkroom is not necessary nor does Ultra-Fi require darkroom chemicals.

For more information contact **Allmakes Micrographics Pty Ltd, 34 Balcombe Rd, Mentone Vic. 3194. (03)584-7811.**

Graphical symbols for electrotechnology

The Standards Association of Australia has published new editions of three parts of its standard dealing with graphical symbols for electrotechnology.

They are AS 1102.3 — resistors, capacitors and inductors, AS 1102.5 — semiconductor devices and AS 1102.8 — location symbols, power and communication installations for buildings and sites. These incorporate amendments to their previous editions, new symbols, the updating of cross references to other Australian standards and the re-numbering of symbols in accordance with the current IEC method.

Copies of AS 1102.3 and AS 1102.8 can be purchased from any SAA office at a cost of $9.80 plus a $1.50 postage and handling charge. AS 1102.5 costs $8 plus a $1.50 postage and handling charge.

Precision pliers

Two pliers in the Channellock Little Champ range are the 43G needle nose and the 41G diagonal cutters.

These general purpose precision pliers are drop forged from high grade steel and polished to a bright finish. Handles are of dipped blue plastic cushion grip.

The complete range of Channellock electronics pliers includes extra long needle nose, flush cutting sharp nose diagonal spring pliers, end cutting nippers, flat nose and round nose pliers, needle nose with side cutters, transverse end cutters and curved needle nose pliers. They are available from **Selectronic Components Pty Ltd, 25 Holloway Drive, Bayswater Vic. 3153. (03)762-4822.**

Blind electronics enthusiasts

Blind people interested in electronics can now check their own projects and equipment.

The students of the Footscray Institute of Technology, assisted by staff lecturer Mr. Michael Fawkner, have developed a multimeter and a standing wave ratio meter which measure with audible signals rather than the conventional needles and lights.

Members of the Radio Enthusiasts Club of the Blind are now using the multimeter which features positive and negative overload sensing. The standing wave ratio meter alerts the user to faults within a transmission line or antenna.

Put it there, mate!

If you put your mind to it, there are a lot of humorous, and somewhat dubious, uses for 'Locoman'. But even though it works with great precision it is an industrial robot, so it can't be expected to cope with all the strange quirks of one's imagination.

Locoman, the second robot from the British company Pendar Robotics Ltd, is controlled by a standard microprocessor. The carbon fibre double parallelograph arm is powered by three electric stepping motors which move it in x, y and z axes at speeds up to one metre per second. It can carry loads up to four kilos and return to any taught or programmed position with an accuracy of ±0.05 mm.

Designed by Birmingham University, the robot can store up to 200 instructions and can operate either continuously or begin each cycle in response to an external command, such as the arrival of the next part in an assembly process.

New address for Australian School of Electronics

The Australian School of Electronics Pty Ltd has moved to 219 Balaclava Rd, Caulfield Vic. 3161.

The new numbers are (03) 523-5622 or (03)523-7544. The address for correspondence has not been changed. P.O. Box 108, Glen Iris Vic. 3146.

Singapore electronic equipment on display

Four Singapore manufacturers of electrical and electronic equipment will display products at the ASEAN Trade Fair in Perth in April.

Portable radios, mono and stereophonic cassette recorders and clock radios will be exhibited by Advanced Concept Technology.

Leo Electronics, which specialises in electronic motor car accessories, will display a full range of its products, including an auto-scanner, multifunction digital clocks, monitoring gauges for battery, headlights, fluid and brakes and wiper control systems.

A compact instant water heater will be exhibited by Prime Electrical Products.

Teco Electric and Machinery, a well-established motor manufacturer and supplier, will exhibit industrial induction motors, such as the single and three-phase squirrel cage induction motors, and an ac/dc magnetic brake motor, a kiln and vibration motor, a helical brake geared motor and an air curtain.

For more information contact **John Yarwood, 21 Clontarf St, Sorrento WA 6020. (09)447-1642.**

Intelligent logic troubleshooting system

Hewlett-Packard's new logic troubleshooting system, the HP 55005A, uses 'built-in intelligence' to guide manufacturing and service personnel quickly through sophisticated checkout procedures.

A specialised software package runs on an HP-85 personal computer which controls an HP 5005B programmable signature multimeter. The HP-85, acting through the signature analyser, learns about the product under development by probing the circuit. A nodal map is created and the circuit connections of the product under test are recorded before it is handed over to manufacturing.

The HP 55005A also allows the engineer to specify critical verification nodes (V-nodes) which can be used later by the system to prompt the manufacturing technician to measure the V-nodes first in the checkout procedure.

Since the troubleshooting system learns the circuit through probing, a new program is not needed for each product. Also, no IC-device libraries must be maintained because the system needs only the IC-pin interconnections.

There are two probing modes of the troubleshooting system. The signature-dictionary mode permits a technician to do free-hand probing through the pc board or backplane under test, searching for incorrect or unstable signatures. The user doesn't need to look at the display of the computer or signature analyser as cues come from a series of beep tones generated by the HP-85. In the backtrace mode the user is prompted to probe a set of points in sequence, tracing a trail of bad signatures back to the bad circuit node.

HP 55005A output documentation of both the circuit database and the checkout process comes almost automatically. A report is printed of the product's signatures by node, by IC and pin number or by troubleshooting tree.

The HP 5005B signature multimeter can also be used for analogue troubleshooting to measure and report frequencies, time intervals, peak voltages, dc voltages, differential voltages and resistance.

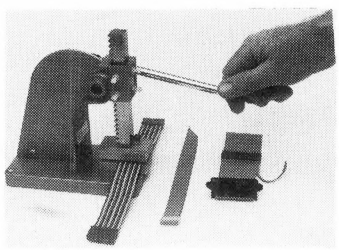
For more information on this product contact **Hewlett-Packard Australia Ltd, 31-41 Joseph St, Blackburn Vic. 3130. (03)890-6351.**

Semi universal insulation displacement connector press

Scope Laboratories has released a termination station Model DILP, complete with tooling, that can handle any insulation displacement plug, socket and 'D' connectors with flat tops and 0.3" or 0.6" pitch top inserted pins (max. 50 pin).

Aimed at the medium sized firm who requires the security of multi-sourcing without the cost and inflexibility of acquiring several custom tooled terminating presses.

The Scope Model DILP, complete with tooling, sells for under $200 through all major electronic trade distributors. Weighing under 3 kg, the press is bench mounted and can be quickly converted to a 225 kg Arbour Press.



For further information contact **Scope Laboratories, 3 Walton St, Airport West NSW 3042. (03)338-1566.**

What's new from Emona?

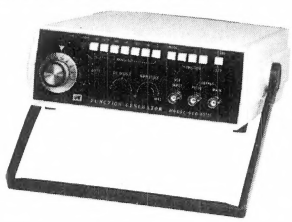
Two frequency counters, a digital LCR meter, a triggering oscilloscope and two function generators are now available from Emona Enterprises.

The frequency counter GFC-8010F has a frequency range from 1 Hz to 120 MHz with a sensitivity of less than 20 mV from 10 Hz to 100 MHz and less than 30 mV in the 100 MHz to 120 MHz range.

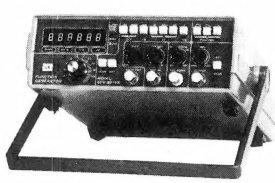
The frequency counter GFC-8100F has a range of 1 Hz to 1 GHz with sensitivities from less than 10 mV at the low end of the range to less than 50 mV at the high end. Both frequency counters have a 8-digit LED display.

The digital LCR meter LCR-2430 has a 5-digit display for LCR and 4-digit for D and Q. The test range is R: 1M — 99.999M, L: 0.2 mH — 9999.9 H, C: 0.1 pF — 99999 UF, D: 0.0001 — 9.999, Q: 0.01 — 999.9.

The triggering oscilloscope GOS-2310 has a sensitivity of 5 mV to 5 V/div, a bandwidth of dc or 2 Hz to 10 MHz and a sweep rate of 10 ms to 0.1 us/div.



The function generator GFG-8015F and the digital display function generator GFG-8016D have a frequency range of 0.2 Hz to 2 MHz, an output level of greater than 20 V_{p-p} open circuit and greater than 10 V_{p-p} into 50 ohm and a VCF of 0 — 10 V.



These instruments can be obtained from **Emona Enterprises Pty Ltd, 661 George St, Haymarket, Sydney NSW 2000. (02)212-4815.**

3½-DIGIT LCD DIGITAL MULTIMETER

by Univolt

SPECIAL ETI READER OFFER

- 8 FUNCTIONS 23 RANGES
- PUSHBUTTON OPERATION
- DC VOLTS TO 1 kV, AC VOLTS TO 750 V
- RESISTANCE FROM 200 OHMS TO 20M
- AUTO-RANGING ON AC/DC VOLTS & RESISTANCE
- AC & DC CURRENT TO TEN AMPS
- FINGER-GUARDS ON PROBES & SHROUDED PLUGS FOR MAXIMUM SAFETY
- TRANSISTOR GAIN MEASUREMENT
- TRANSISTOR CLIP LEAD INCLUDED
- PROTECTIVE CARRY CASE INCLUDED

Here is an opportunity to buy a versatile, top-line multimeter at a very good price, complete with carry case, special probes, leads and spare fuse.

OFFER PRICE
$97.50 tax paid
$84.38 tax exempt

DT-860 UNIVOLT LCD DIGITAL MULTIMETER

SPECIFICATIONS

- **3½-digit** liquid crystal display; 12 mm high digits.
- **dc volts** — 200 mV-1000 V (max) **auto-ranging;** resolution: 0.1 mV @ 200 mV, 100 mV @ 200 V.
- **ac volts** — 2 V-750 V (max.) **auto-ranging;** resolution: 1 mV @ 2V, 100 mV @ 200 V.
- **resistance** — 200 ohms-20 M **auto-ranging;** resolution: 0R1 @ 200R, 10k @ 20M.
- **ac/dc current** — 2000 uA/200 mA/10 A; overload protected; resolution: 1 uA/100 uA/10 mA.
- **h_{FE}** — 0-1999 (±10%) with V_{ce} = 1.2 V, I_b = 1 uA.
- **continuity** — buzzer sounds at resistances under 20 ohms (±10R)
- **diode check** — reads forward drop in millivolts at 0.6 mA test current; 1 mV resolution.
- **warranty** — three months normal parts and labour warranty.
- **miscellaneous** — input impedance 10M minimum; input capacitance less than 50 pF; polarity: '−' indicated automatically; overrange indicated by '1' or '−1'; size: 145(D)x82(W)x28(H) mm; weight: 180 g excluding batteries; protection provided by 0.2 A, 250 V fast blow fuse.

ACCURACY

- **dc volts** — 200 mV; ±(0.5% of rdg + 2)
  2 V/20 V; ±(0.5% of rdg + 1)
  200 V/1 kV; ±(0.7% of rdg + 1)
- **ac volts** — 2 V/20 V; ±(0.5% of rdg + 5)
  200 V/750 V; ±(1.0% of rdg + 5)
- **dc current** — 2 mA/200 mA; ±(1.0% of rdg + 1)
  10 A; ±(1.2% of rdg + 1)
- **ac current** — 2 mA/200 mA; ±(1.2% of rdg + 5)
  10 A; ±(2.0% of rdg + 5)
- **ohms** — 200R; ±(0.75% of rdg + 3)
  2k/20k/200k; ±(0.5% of rdg + 2)
  2M; ±(1.0% of rdg + 2)
  20M; ±(2.0% of rdg + 3)

max. open circuit voltage = 1.5 V on 200R range
max. open circuit voltage on other ranges = 0.65 V

This instrument would normally sell for about $130 retail.

This is an entirely new multimeter from Univolt and this offer is being made as a special promotion for the Model DT-860 which has only just been released here. It is a 3½-digit liquid crystal display instrument featuring 23 ranges in eight functions, three functions being auto-ranging. It is a handheld instrument but comes with a tilt stand to prop it up from the bench. The display features 12 mm high digits, plus value and function indicators (volts, ohms, ac, low battery, −ve, etc). The front panel is functional and well laid out. The test probes supplied have shrouded plugs to prevent accidental finger contact for safety when using the instrument on high voltage circuits, plus the probes have finger guards for further safety and convenience. A strong, synthetic leather carry case is included. The instrument is powered by two 1.5 V 'AA' cells. We have tested a sample DT-860 in the ETI Lab and found it met specifications, functioned well and was generally easy to use. It appears to be a robust, well-made device. Any technician, engineer, serviceman or hobbyist would find it a very useful instrument.

This offer is made by BENELEC PTY LTD (Incorporated in NSW). ETI is acting as a clearing house for orders. All mail orders will be despatched by certified post. Please allow up to four weeks for delivery. Offer closes 31 March 1983.

INSPECTION

You can inspect one of these multimeters during office hours at ETI's Sydney and Melbourne offices:

Sydney:
4th Floor, 15 Boundary St
Rushcutters Bay

Melbourne:
23rd Floor, 150 Lonsdale St
Melbourne

HOW TO ORDER YOUR MULTIMETER

Fill out the coupon below and enclose a cheque, bank cheque or money order for the amount required made out to **BENELEC PTY LTD.**

If you are not paying sales tax, please quote your sales tax number on the coupon, where indicated, or for schools, colleges or other educational institutions, enclose a sales tax declaration on your letterhead.

SEND completed coupon to:

UNIVOLT MULTIMETER OFFER
c/o ETI MAGAZINE, 140 Joynton Ave, Waterloo NSW 2017.

STOP PRESS

We will be moving premises sometime in February. Please phone 662-8888 if you want to inspect a DT-860 in Sydney to check which address we'll be at.

PLEASE SEND ME ..... **Univolt Model DT-860 multimeter(s) @ $84.38 each, excl. tax or $97.50 each, inc. tax.**

Post and handling $2.50 **Sales Tax No** ..... **(if applicable)** **Offer closes 31 March 1983**

I enclose $ ..... **total** **Cheque or Money Order No.** ..... **Signature** .....

Name .....

Address ..... **Postcode** .....

Rotary switch — in a DIL package!

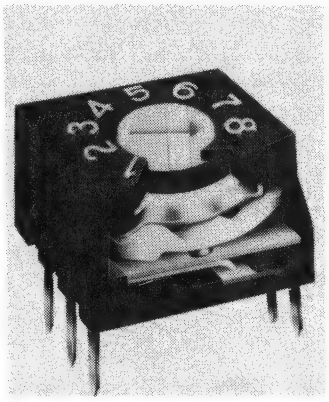
A new rotary switch in a dual-in-line package has been released by The New Ohto Co, represented here by Associated Controls.

The switch incorporates a well-proven contact construction, utilising 'knife edge high pressure' contacts to ensure reliable operation and long life, according to the makers.

The high pressure edge contact, it is claimed, will break any film formed by oxidation or sulfurisation. Life expectancy is quoted as 20 000 cycles or more.

The miniaturised switch allows high density packing on a pc board. Pin spacing is standard 2.54 mm (0.1") and the switch can be inserted in a standard IC socket, if necessary.

The terminals are all moulded into the fully-sealed housing which prevents ingress of moisture, solder flux or other contaminants. The switch can be flow-soldered and is immersion washable.



Associated Controls has also released the 'K' series DIL switches from The New Ohto Co, having similar features.

Further details from **Associated Controls Pty Ltd, P.O. Box 21, Padstow NSW 2211. (02)709-5700.**

3½ digit voltmeter IC

A 3½ digit voltmeter IC with the facility to remove the zero errors of external signal conditioning circuits is now available from Ferranti Electronics, Fields New Rd, Chadderton, Oldham UK.

Called the ZN451, the chip does not include auto-zero switches, but two logic outputs are provided to control external auto-zero switches. Op-amps and other signal conditioning circuits can thus be included inside the auto-zero loop and have their errors removed by the ZN451 digital auto-zero system. This allows the chip's basic ±199.9 mV full-range scale to be reduced to as low as ±1.999 (one microvolt resolution) while still retaining the auto-zero facility by using a low cost op-amp with a gain of 100.

In addition, the combination of charge-balancing measurement technique and digital auto-zero offers good linearity, a well-defined conversion time and freedom from the layout-dependent stray capacitance problems sometimes associated with dual-slope designs.

Other features of the ZN451 include on-chip clock and precision bandgap reference, underrange/overrange, display hold facility and direct drive of liquid crystal display.

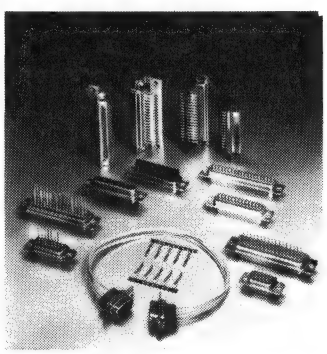
For further information contact the **British High Commission, Commonwealth Avenue, Canberra ACT 2600. (062) 73-0422.**

Crimp versions of F161 connectors

Crimp versions have been added to Philips F161 range of subminiature rack and panel connectors.

These new versions accept AWG20 to AWG30 solid or stranded wire, are internationally standardised and are suitable for all areas of industry, especially telecommunications and data processing applications.

Each connector consists of a glass-fibre filled thermoplastic insulating block into which crimpable pins and sockets are inserted. The contact pins and sockets are made of copper alloy and are selectively gold plated on a nickel layer.

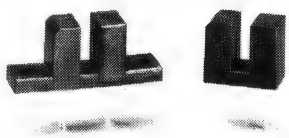


A modern, semiautomatic electric stripping/crimping machine (speed approx. 2000 crimps/h) is available.

For further information contact **Elcoma, 67 Mars Rd, Lane Cove NSW 2066. (02)427-0888.**

Slotted optocoupler/ interrupter modules

Motorola has a series of six slotted optocoupler/interrupter devices which represent drop-in replacements for the G.E.H21 and H22 series.



These devices consist of a gallium arsenide infrared emitting diode facing a silicon NPN photo transistor, encapsulated in a molded plastic housing. A slot in the housing between the emitter and the detector provides a means of interrupting the optically coupled signal by means of an externally introduced opaque material such as a card, tape or disk.

The slotted optocouplers are widely used in video games, copy machines, keyboards, card readers, garage door openers, tape drives and floppy and hard disk drives. Other applications include position and motion indicators, digital pressure sensors, scales, industrial machine controls, limit switches etc.

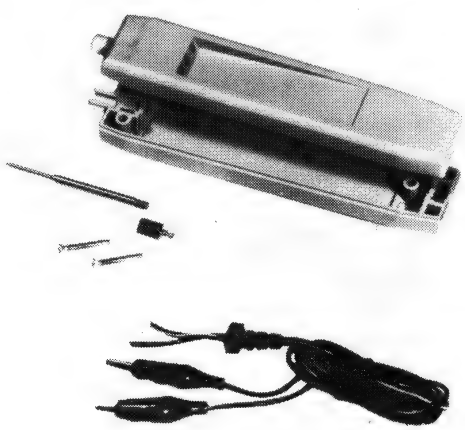
These devices are available from **Motorola Semiconductor Products, 250 Pacific Hwy, Crows Nest NSW 2065. (02) 438-1955.**

Probe case and hardware

The GSC — CTP1 probe case, complete with associated hardware, is ideal for housing signal injectors, logic probes, small counters, voltage and resistance probes and continuity checkers.

The moulded grey plastic case measures 147 x 25 x 18 mm and is supplied with a one meter long two wire lead with a moulded strain reliever and alligator clips attached and a nickel plated screw-in probe tip. Also included are a mating tapped hex probe tip connector, assembly screws and a blank pc board pre-cut to size.

These are available from **Commquip Pty Ltd, Unit 2, 9 Douglas St, West Perth WA 6005. (09)328-9451.**



MARCH MAD

JAYCAR'S FIRST "MARCH MADNESS" SALE. EVERYONE HAS HAD ONE.

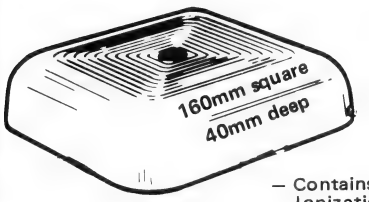
MORE HAVE BEEN FOUND!!

Last month we did not advertise the GE Smoke and Burglar Alarms. This is because our stocks were getting very low and we did not expect to have any left by February.

We were more surprised than anyone when we found another consignment arrive on our front door! This is great news as we have never seen a greater bargain then these products – as thousands of you will already testify! The Smoke Detector was a flop at $49.50 (see story below) BUT at $14.50 its the bargain of the century. So too the Burglar Alarm – at about ½ THE PRICE of its closest competitor!!

final runout of GE Consumer Products

Burglar Alarm



Cat. LA5006

FROM $12.50

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- 12 month factory warranty.

One of the greatest consumer flops of the last decade was the Ionization Chamber Smoke Detector. Even though it is a brilliant product (reliable compact, easy installation, fail-safe etc) it just did not sell. Human nature being what it is finds safety-oriented products just not worth the investment. We all know that accidents and fires never happen to US!! As smoke is the greatest killer in a fire, the market research gurus thought that such a product would have a wide appeal. When they were $49.50 no-one wanted them. The price fell to a very reasonable $29.50 and still they stayed on the shelf. We have now been instructed to clear them for less than ⅓ of $29.50.

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1-$14.50: 2-5 $13.50ea: 6-10 $13.00ea: 10 up $12.50ea

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BURGLAR ALARM SLASHED!!!
HUGE SCOOP PURCHASE –
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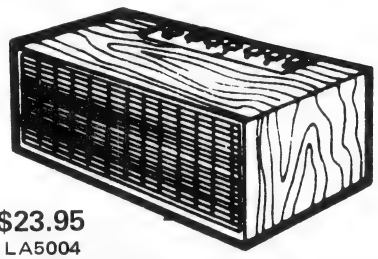

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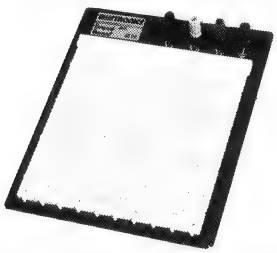

Many of the Tech Colleges and CAE's are specifying plug-in bread boards as training aids in their Electronics and Radio courses. At around March Breadboards get VERY scarce as thousands of students buy all available stocks. Jaycar has stocked up especially this year but we may be out of stock later in March if you don't act quickly.

Cat. PB8810 WB-DN 100 holes $2.95
Cat. PB8812 WB-TN 640 holes $8.95
Cat. PB8814 WB-2N 840 holes $12.95
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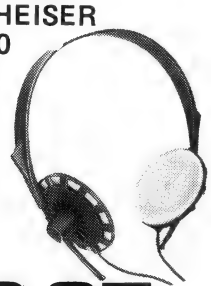

$29.95

PRE-SALES TAX INCREASE PRICE

Sennheiser – the name that means the ultimate in Headphone technology. These are high quality West German made units that are now available at a bargain basement price. As used in the 1st class section of the TAA Airbus and all Qantas 747's (1st class). Naturally the frequency response is a flat 20-20KHz. Impedance is 8 ohms.

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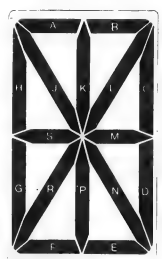

We have a small number of specific liquid crystal displays in stock. Each unit described below is supplied with a specific data sheet for that product as well as application notes re: drive requirements, multiplexing etc.

TYPE 5301A-51 This is a 3" high Starburst display which enables you to display all letters of the alphabet and 0-9 digits. Each segment is addressable. A large, high contrast display can be achieved. Normally around $25 each a small quantity available at $10 each ONLY $10 EACH – Cat. ZM9010

TYPE H5545-54 This is a 4 digit x 0.5" high display with "plus", "minus" and "arrow" annunciators, with 4 decimal point locations. Normally $20 each – ONLY $7.50 each Cat. ZM9011

TYPE L-5640 – 51 & 54 This is basically identical to the H-5545 except that the digits are 0.6" high with a colon as well as the decimal point. Normally $22 each ZM9012(51) & ZM9013(54) $9.50 ea

TYPE L-563A-51 A 3½ digit 0.6" high 12 hour clock display with AM/PM annunciator and colon. Normally $15 EACH – NOW ONLY $7 EACH Cat. ZM9014

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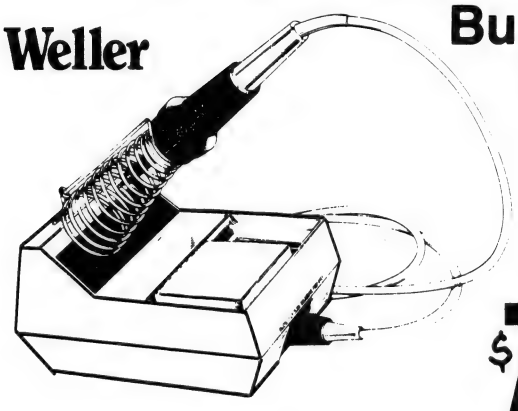

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But if you don't have a thermocouple, consider the WTCPN.
The WTCPN Station uses an exclusive world-patented principle which guarantees that the temperature of your iron will not drift once you have set it up.
But the best news is the price. 7½% sales tax went on this equipment on January 1 this year. Jaycar still has stock at the pre-sales tax price. This stock will not last and the price of the Weller Station MUST GO UP.
Cat. TS1000

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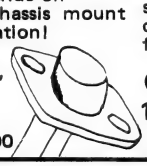
March Madness!! $0.75 each or $5 for 10! – has exclusive slide-on flange to convert to chassis mount for greater power dissipation!
SPECS: NPN Silicon – Vce 40V, Vcb 80V, Veb 5V – Ic 3A, hFE 50-90 – Ft 150MHz. Cat. ZT2600



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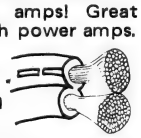

4116 RAMs 150nS – GOING CHEAP

We have secured a quantity of 4116 (150nS) RAMs at a price which means great savings to you.
Why are they cheap? Well they don't actually have '4116' branded on them. They have '9016 FPC' on their little backs. They are used in a well known TV-game computer and this is the 'House Number' for their 4116. If you have ever had to buy a non-standard replacement part you will know that the 'House Number' part can be VERY expensive. We don't want to sell them as 9016 FPC's we want to sell them as 4116's – and at a great price. The normal (i.e. lower than most) price for our 250nS 4116 is $2.50 You can grab a 9016 FPC (150nS) 1-off for only $1.95!!!
For larger quantities see below:

Cat. ZZ8419

This price includes sales tax!!

1-9 pcs $1.95
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For years and years 240V mains powered strobes have been selling for between $30 and $40. Even kits are around $36. So why is it that Jaycar can sell a 240V strobe – guaranteed – for $12.50?
We can tell you for a start that we're not selling them below cost. Even at $12.50 we're doing OK.
Why so cheap?
Well they were made for a well known electronics chain. Their Q.C. (Quality Control) Department rejected them on the grounds that around 5% of them were faulty. That was an unacceptable figure considering the very good name that the chain has in this country. All goods were rejected (even the 95% good ones) and sent back to the importer.
The importer came to us with his problem. We said that we would sell them PROVIDED we could offer a 90 day guarantee on the item.
Whilst all stock has been checked and the duds weeded out we STILL feel that even at $12.50 you deserve a comeback if we sell you faulty goods.
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SCRs, triacs and power control

SCRs and triacs are high speed solid state switches specifically intended for use in ac and dc power control applications. Ray Marston explains their basic principles in this edition of Circuit File, to be followed next edition with a stack of application circuits.

Ray Marston

FOR ELECTRONIC switching applications in dc and ac circuits, SCRs and triacs have no equals and wide application. The SCR is like a diode you can turn on and off while the triac is like two back-to-back diodes you can turn on and off (back-to-back SCRs!). That's the easiest way to think of these two very useful, related, devices. But to be able to appreciate their characteristics and how to use them, you need to know about them in somewhat more depth. So, let's look at some basic theory and circuits first.

The SCR: basic theory

The SCR, or silicon controlled rectifier, is a four-layer pnpn semiconductor switching device. It is represented by the symbol shown in Figure 1a. Figure 1b shows the transistor equivalent circuit of the SCR, which takes the form of a complementary regenerative switch in which the base current of Q1 is derived from the collector of Q2 and the base current of Q2 is derived from the collector of Q1. Figure 1c shows the basic connections for using the SCR as a switch in dc power control circuitry. The basic characteristics of the SCR can readily be understood with the aid of Figures 1b and 1c, and are as follows.

(1) When power is first applied to the SCR (by closing SW1 in Figure 1c) the SCR is 'blocked' and acts like an open-circuit switch. This action can be understood by looking at Figure 1b, where it can be seen that, since Q1 base is shorted to the cathode via R1-R2, Q1 is cut off through lack of base current and thus feeds no base drive to Q2, which is also cut off. As both transistors are cut off under this condition only a small leakage current flows between the anode and cathode of the device.

(2) The SCR can be turned on and made to act like a closed switch (or forward-biased silicon rectifier) by simply applying positive gate current by closing SW2 in Figure 1c. This gate current causes the SCR to switch on very rapidly.

If the externally-applied gate current is sufficiently large it will apply base drive to Q1, causing Q1 to start to turn on. As Q1 starts to turn on, its collector current feeds base drive to Q2, causing Q2 to turn on and feed increased base drive into Q1, etc. A fast regenerative action thus takes place, with both transistors switching rapidly into saturation, the total saturation voltage typically being in the range one to two volts.

(3) Once the SCR has been turned on and is conducting significant forward current, the gate loses control and the SCR remains latched on even if the gate drive is subsequently removed. Thus, only a brief pulse of gate current is needed to latch the SCR on. Note from Figure 1b that, because of the presence of R1 and R2, the SCR can *not* be turned off by shorting or reverse-biasing the gate-cathode terminals of the device.

(4) Once the SCR has latched into the on state it can only be turned off again by momentarily reducing its anode current below a value known as the 'minimum holding current'. Since turn-off occurs whenever the current is reduced below this critical value, it follows that turn-off occurs automatically in ac circuits near the zero-crossing point at the end of each half-cycle.

(5) Internal capacitance inevitably

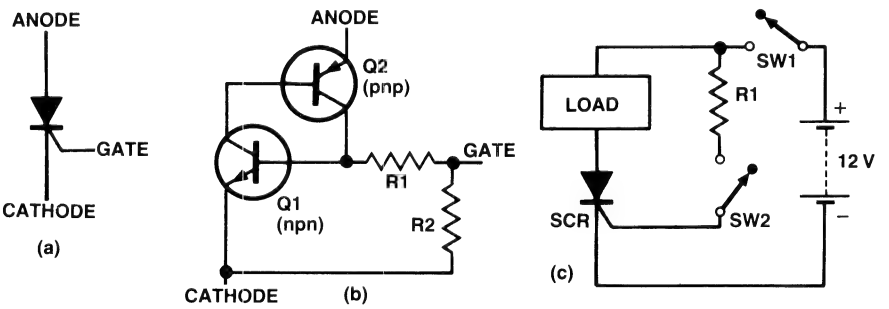

Figure 1. (a) SCR symbol (b) transistor equivalent circuit of the SCR and (c) basic connection for using the SCR as a dc power-control switch.

DATA FILE 7

DEVICE TYPE NO.	PIV RATING	TOTAL CURRENT RATING, RMS/average	V_{GT} (max)	I_{GT} (max)	I_H (max)
TAG 1/100	100 V	1 A/0.64 A	2.5 V	10 mA	25 mA
TAG 1/600	600 V	1 A/0.64 A	2.5 V	10 mA	25 mA
C106D	400 V	4 A/2.5 A	0.8 V	0.2 mA	3 mA
2N3525	400 V	5 A/3.2 A	2 V	15 mA	20 mA
BT109	500 V	6.5 A/4 A	2 V	15 mA	3 mA
IR122A	100 V	8 A/5 A	1.5 V	25 mA	30 mA
IR122D	400 V	8 A/5 A	1.5 V	25 mA	30 mA
C116D	400 V	8 A/ 5 A	1.5 V	20 mA	35 mA
C126M	600 V	12 A/7.5 A	1.5 V	30 mA	35 mA

Figure 2. Basic details of some of the most popular SCRs.

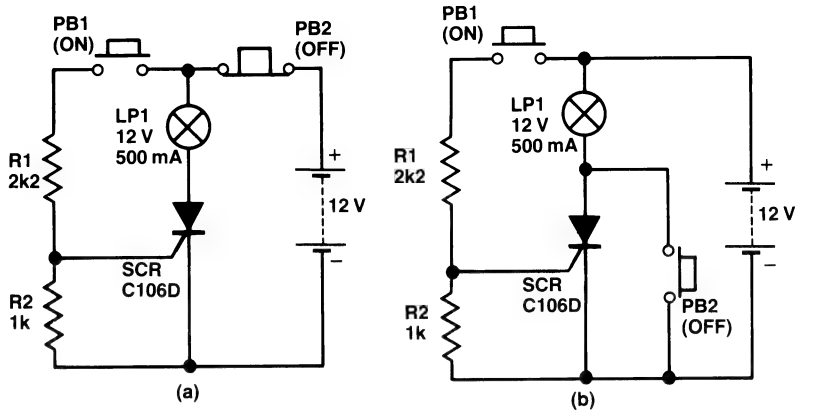

Figure 3. (a) Simple dc on/off circuit and (b) alternative dc on/off circuit.

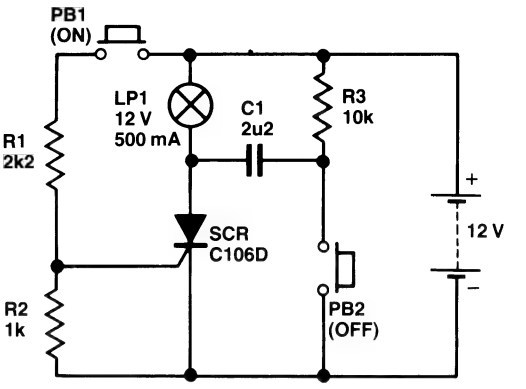

Figure 4. Capacitor turn-off circuit.

exists between the anode and gate of the SCR. Consequently, if a sharply rising voltage is applied to the SCR anode this internal capacitance can cause part of the rising voltage to break through to the gate and thus trigger the SCR on. This 'rate-effect' turn-on can be caused by supply-line transients, and sometimes occurs at the moment that supplies are switch-connected to the SCR anode. Rate-effect problems can usually be overcome by wiring a simple RC 'snubber' network between the anode and cathode of the SCR, to limit the rate-of-rise to a safe value.

These then, are the basic characteristics of the SCR. As you can see, it's a pretty simple device. If you ever need to select an SCR for a particular application, you'll usually find that the most significant parameters are the main voltage and current ratings, plus the gate sensitivity rating and (occasionally) the device's 'minimum holding current' value. The list of Figure 2 gives basic details of a few of the most popular SCRs.

The SCR: basic dc circuits

SCRs have applications in both dc and ac power control circuitry. Let's look first at some basic dc circuits. Figures 3a and 3b show alternative ways of using the SCR as a pushbutton-controlled on/off power switch feeding a 12 volt, 500 mA lamp. In both circuits the lamp and SCR can be latched on by momentarily closing PB1, thereby feeding gate drive to the SCR via R1. Note that the gate is tied to the cathode via R2, to give improved stability. Once the SCR has latched on, it can only be turned off again by momentarily reducing the anode current below the device's I_H value; in Figure 3a this is achieved by momentarily opening PB2; in Figure 3b the turn-off action is achieved by using PB2 to place a momentary short between the anode and cathode of the SCR.

Figure 4 shows another way of achieving SCR turn-off. Here, once the SCR has turned on, C1 charges up to almost the full supply voltage via R3 and the SCR anode, with the R3 end going positive. When PB2 is subsequently closed it clamps the positive end of C1 to ground, and the C1 charge forces the SCR anode to momentarily swing negative, thereby reverse-biasing the SCR and causing it to turn off. The capacitor charge bleeds away rapidly under this condition, but has to hold the SCR anode negative for only a few microseconds to ensure complete turn-off. Note that C1 must be a non-polarised component.

A variation of the capacitor turn-off circuit is shown in Figure 5. A slave SCR is used to replace PB2 of Figure 4 and capacitive turn-off of SCR1 is achieved by briefly driving SCR2 on via PB2. SCR2 turns-off once PB2 is released, since the anode current provided by R3 is lower than the SCR2 holding current.

Figure 6 shows how the above circuit can be modified so that it acts as an SCR bistable or flip-flop driving two independent lamp loads. Assume that SCR1 is on and SCR2 is off, so that C1 is fully charged with its LP2 end positive. The state of the circuit can be changed by briefly operating PB2. SCR2 is then driven on via its gate, and as it goes on it drives SCR1 off capacitively via its anode. C1 then recharges in the reverse direction. The state of the circuit can then again be changed by briefly operating PB1, thus driving SCR1 on via its gate and driving SCR2 off capacitively via its anode. The flip-flop process is repeated ad infinitum.

The dc circuits that we have looked at so far have all used simple resistive 'lamp' loads and have inevitably produced a self-latching ▶

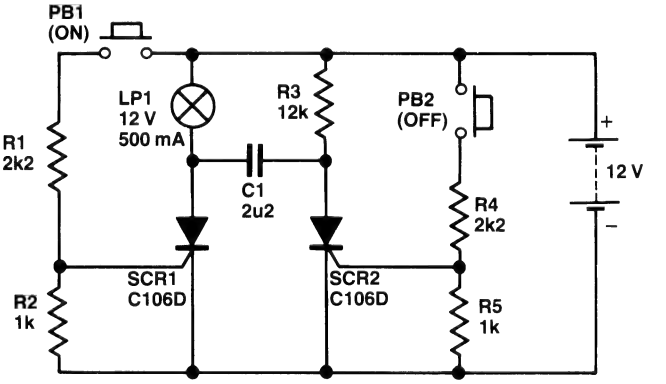

Figure 5. Capacitor turn-off with SCR slaving.

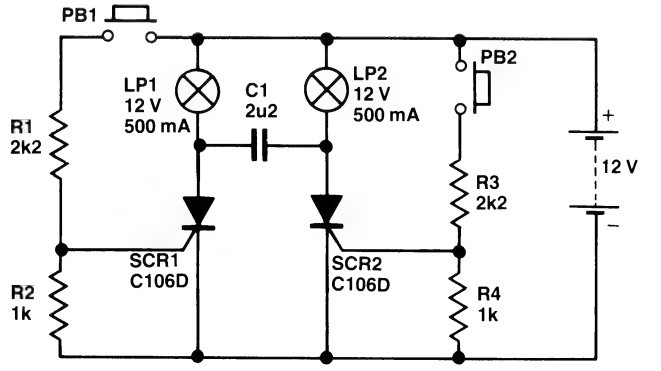

Figure 6. SCR bistable or flip-flop.

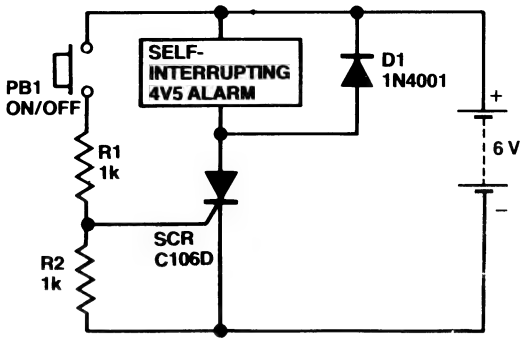

Figure 7. Simple non-latching alarm circuit.

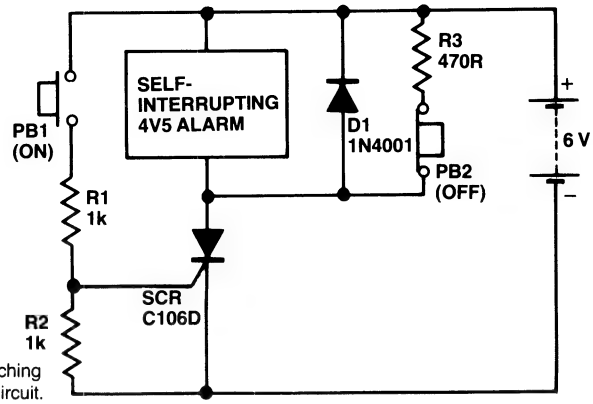

Figure 8. Simple self-latching alarm circuit.

action in the SCRs. Figure 7 however, shows a simple dc alarm circuit driving a self-interrupting load such as a bell or buzzer, and gives a non-latching action.

When self-interrupting devices such as bells or buzzers are connected across a supply, a current flows through a built-in solenoid via a pair of contacts. This current induces a magnetic field in the solenoid and causes a striker to fly outwards and open the contacts, causing the current to fall to zero and making the magnetic field collapse. Once the field has collapsed the striker falls back again and the contacts close, so current is again applied to the solenoid and the action repeats. Consequently, this type of load acts like a switch that repeatedly opens and closes rather rapidly.

When such loads are connected in the Figure 7 circuit therefore, the circuit does not self-latch in the normal way and the alarm operates only so long as PB1 is closed. Because of the inductive nature of such loads, a damping diode must be wired across them when they are used in SCR circuits, as shown in the diagram.

The Figure 7 alarm circuit can be modified to give a self-latching action if required by simply wiring a 470R (or lower) resistor in parallel with the alarm, as shown in Figure 8. In this case, the anode current of the SCR does not fall to zero when the alarm self-interrupts, but falls to a value determined by R3. If this value is in excess of the SCR's 'holding' value, the SCR self-latches. The circuit can be unlatched by briefly operating PB2, enabling the anode current to fall to zero when the alarm self-interrupts.

Finally, to complete this section, Figure 9 shows a circuit that can be used to demonstrate the rate-effect turn-on of the SCR, and a method that can be used for rate-effect suppression. Here, the SCR uses a 3 V lamp as its anode load, and is connected across the 4V5 battery supply via SW1. A 4V5 domestic door bell can be connected across the supply via PB1, and enables transient modulation to be applied to the supply line and thus to the anode of the SCR. This modulation can cause rate-effect turn-on of the C106D SCR, which has a critical slew rate of 20 V/us. The network R2 and C1 form a 'snubber' or rate-effect suppression network and can be connected to the SCR via SW2.

To demonstrate the rate-effect, open SW2, close SW1, and then close PB1 so that the bell rings. The resulting supply line transients should be enough to trigger the SCR and turn the lamp on; if not, wire a one ohm resistor in series with the battery. Once the SCR and lamp have been triggered on, they can be turned off again by briefly opening SW1.

Once the turn-on rate-effect has been demonstrated, the effect of the suppressor network can be demonstrated by closing SW2 and SW1 and then operating the bell via PB1. The lamp resistance (plus R2) acts with C1 as a smoothing network that reduces the rate of rise of the anode modulation signal, thereby protecting the SCR against false triggering. R2 is wired in series with C1 to limit the capacitor's discharge currents to safe values when the SCR is triggered on via legitimate signals.

The SCR: basic ac circuits

Figure 10 shows a basic halfwave on/off circuit driving a 100 W lamp from a 120 or 240 Vac power line. With SW1 open, zero gate drive is applied to the circuit, so the lamp and SCR are off. Suppose however, that SW1 is closed. On negative half-cycles, the SCR is reverse biased and gate signals are inhibited by D1, so the SCR is off. On positive half-cycles, the SCR is initially off at the start of each half-cycle, so the full available line voltage is applied to the gate via the lamp and D1-R1; shortly after the start of the half-cycle sufficient voltage is available to trigger the SCR, which turns on. As the SCR goes on its anode voltage falls to near zero, thus removing the gate drive but the SCR remains self-latched for the duration of the half-cycle. The SCR automatically turns off again when the half-cycle ends and the anode current falls to zero.

The Figure 10 circuit gives halfwave operation only. Figures 11 and 12 show alternative ways of obtaining fullwave operation. In these circuits, the ac is converted to rough (unsmoothed) dc via a bridge rectifier and the rough dc is applied to the SCR. With SW1 open the SCR is off, so zero current flows through the bridge and the load. When SW1 is closed the SCR is driven on shortly after the start of each half-cycle of rough dc, so fullwave power is applied to the load. As the SCR goes on in each half-cycle, the gate drive is automatically removed but the SCR stays latched on for the duration of the half-cycle. The SCR switches off at the end of each half-cycle as its anode current falls to zero, so power is removed from the load when SW1 is opened.

Note in the Figure 11 circuit that the load is connected to the dc side of the bridge. A fuse must be placed on the ac side of the bridge, to give protection in the event of a short in the bridge rectifier. In the Figure 12 circuit the load is placed in the ac side of the bridge, which does not need fuse protection since the load itself will limit currents to a safe value in the event of a bridge failure.

A pair of SCRs can easily be wired in

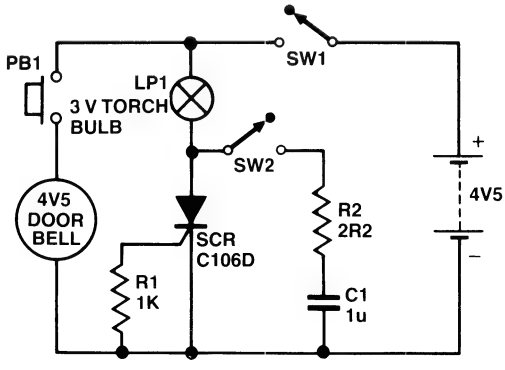

Figure 9. Rate-effect demonstration circuit.

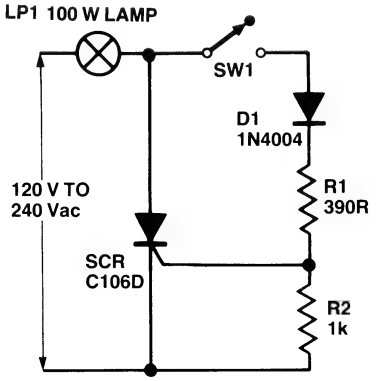

Figure 10. Line driven halfwave on/off circuit.

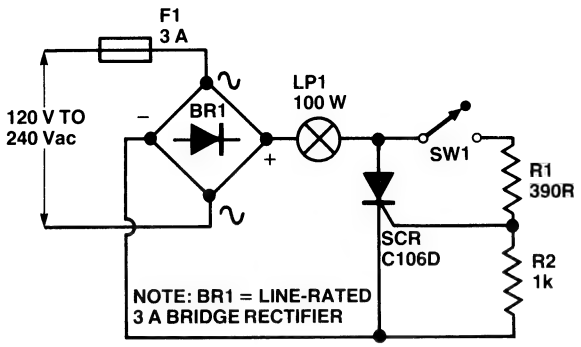

Figure 11. Fullwave on/off circuit.

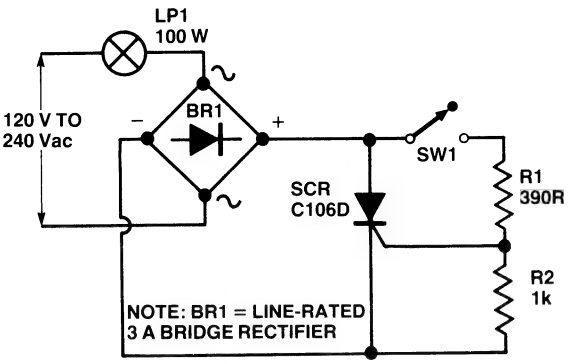

Figure 12. Alternative connection for fullwave on/off circuit.

inverse parallel and used to give fullwave power control without the use of additional rectification. In reality, however, a far more effective way of obtaining fullwave power control is to use a triac in place of the SCRs. Let's now look at triac basics.

The triac: basic theory

A triac can be regarded as being equal to two conventional SCRs connected in inverse parallel within a single three-terminal package, but so arranged that they share a single gate terminal. The triac acts as a solid state power switch that can conduct current in either direction and can be switched from the off to the on state by a gate signal of either polarity.

Figure 13a shows the triac symbol and Figure 13b shows a basic connection for using the device as an ac power switch. The load is wired in series with the triac's main terminals, the combination being wired directly across the ac power line. By closing SW1 dc gate drive can be applied to the triac. Referring to Figure 13b, the basic characteristics of the triac are as follows:

(1) Normally, with no gate signal applied, the triac is off and acts (between MT1 and MT2) like an open circuit switch.

(2) If MT2 is appreciably positive or negative relative to MT1 the triac can be turned on (so that it acts like a closed switch) by applying a gate signal via SW1. The device takes only a few microseconds to turn on. A saturation potential of one or two volts is developed across the triac in the on mode. Once the triac has turned on it self-latches and remains on so long as main-terminal current continues to flow. Only a brief pulse of gate current is thus needed to turn the triac on.

(3) Once the triac has self-latched the gate loses control and the triac can only be turned off again by reducing its main-terminal current below a minimum holding value. When the triac is used as an ac power switch therefore, turn-off occurs automatically near the zero-crossing point at the end of each half-cycle as the main-terminal currents fall to zero.

(4) The triac can be turned on by either a positive or negative gate signal, irrespective of the polarities of the main-terminal voltages. The device thus has four possible triggering modes or 'quadrants', signified as follows:

I+ Mode, MT2 current = +ve, I_{gate} = +ve.
I− Mode, MT2 current = +ve, I_{gate} = −ve.
III+ Mode, MT2 current = −ve, I_{gate} = +ve.
III− Mode, MT2 current = −ve, I_{gate} = −ve.

Gate sensitivities in the I+ and III− modes are approximately equal and about twice as high as in the I− and III+ modes.

(5) Triacs can handle very high surge or non-repetitive currents. Typically, a device with a 10 A RMS rating may be able to handle a single-cycle, non-repetitive 50 Hz surge current of 100 amps!

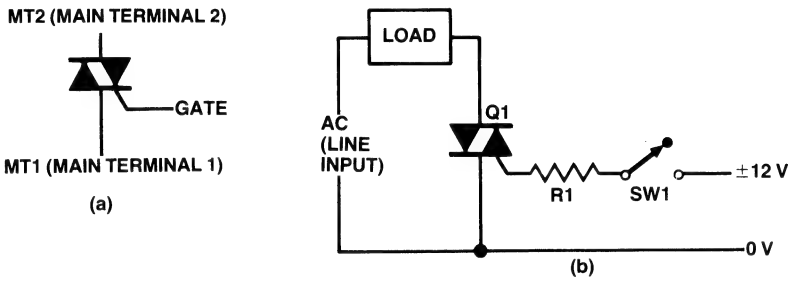

Figure 13. (a) Triac symbol and (b) basic triac circuit with dc gate drive.

Figure 14 shows basic details of a limited range of popular triacs. In most applications this limited information is sufficient for user needs. Let's now move on and look at some basic ways of using the triac.

The triac: basic circuits

Figure 15 shows the practical circuit of a simple dc-triggered triac power switch in which the dc supply is derived via step-down transformer T1. When SW1 is open, no current flows to the gate of the triac, which is thus off. When SW1 is closed, gate drive is ▶

DEVICE TYPE NO.	PIV RATING	TOTAL CURRENT RATING RMS	V_{GT} (max)	I_{GT} (max)	I_H (max)
C206D	400 V	3 A	2 V	5 mA	30 mA
2N6073	400 V	4 A	2.5 V	30 mA	70 mA
C226D	400 V	8 A	2.5 V	50 mA	60 mA
SC146D	400 V	10 A	2.5 V	50 mA	75 mA
TIC246D	400 V	15 A	2.5 V	50 mA	50 mA

Figure 14. Basic details of some popular triacs.

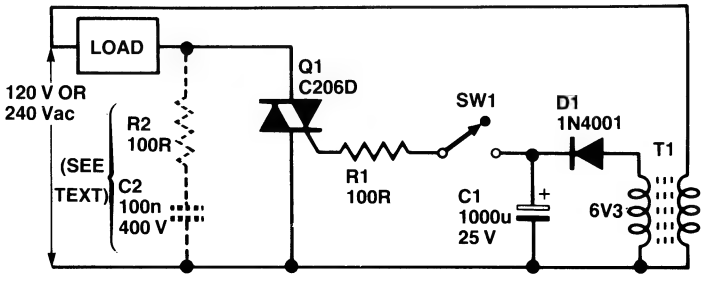

Figure 15. Simple ac power switch with dc gate triggering.

applied to the triac so it and the load are driven on. If an inductive load, such as a motor, is used in this circuit the R2-C2 'snubber' network must be wired in place as indicated to prevent false-triggering by rate-effects.

Note in the Figure 15 circuit that the dc side of the circuit is connected directly to one side of the mains and is thus 'live'. This snag is overcome in the UJT-triggered isolated-input circuit of Figure 16. Here, the UJT (unijunction transistor) operates at several kilohertz and thus delivers roughly 50 trigger pulses to the gate of the triac — via isolation pulse transformer T1 — during each half-cycle of the ac power line waveform. Consequently, the triac is fired by the first trigger pulse occuring in each mains half-cycle, and this pulse occurs within a few degrees of the start of the half-cycle. The triac is thus turned on almost permanently when SW1 is closed and virtually full power is applied to the ac load. The trigger circuit is, however, fully isolated from the mains by transformer T2 and pulse transformer T1.

Figure 17 shows how the triac can be used as a simple line switch with line-derived triggering. With SW1 open, zero gate drive is applied so the triac and lamp are off. Suppose however, that SW1 is closed. At the start of each half-cycle the triac is off, so the full line voltage is applied to the gate via the lamp and R1. Shortly after the start of the half-cycle, enough drive is available to trigger the triac and the triac and lamp go on. As the triac goes on and self-latches it saturates and automatically removes the gate drive until the start of the next half-cycle, thus minimising the dissipation in R1.

Finally, Figure 18 shows how the above circuit can be modified to give either half-wave or fullwave operation. In the halfwave mode, the gate drive is applied via D1, so the triac triggers on positive half-cycles only. In the fullwave mode the triac triggers on both positive and negative half-cycles, as in the case of the Figure 17 circuit.

Phase-triggered power control

The SCR and triac circuits that we have looked at so far have all been designed to give a simple on-off form of power control. These devices can easily be used to give fully-variable power control in ac circuits and are widely used in lamp dimmers and electric motor speed controllers, etc. The most widely used system of ac variable power control is known as the 'phase triggering' system.

Figure 19 illustrates the principle of phase-triggering using a triac as the power control element. Here, instead of the triac being triggered 'directly' from the ac power line, it is triggered via a variable phase-delay network that is interposed between the power line and the triac gate. Thus, if the triac is triggered 10° after the start of each half-cycle, almost the full available line power is fed to the load. If the triac is triggered 90° after the start of each half-cycle, only half of the available line power is fed to the load. Finally, if the triac is triggered 170° after the start of each half-cycle, only a very small part of the available power is fed to the load.

The three most popular methods of obtaining variable phase-delay triggering are to use either a line-synchronised UJT, a special-purpose IC, or to use a diac plus RC network in the basic configuration shown in Figure 20.

The diac can be regarded as a bilateral threshold switch. When connected across a voltage source, it acts like a high impedance until the applied voltage rises to about 35 volts, at which point it switches into a low impedance state and remains there until the applied voltage falls to about 30 volts, at which point it reverts to the high impedance mode. It then stays in this state until the applied voltage rises back to 35 volts, at which point the process repeats.

In the Figure 20 circuit, in each mains half-cycle the R1C1 network applies a variable phase-delayed version of the mains waveform to the triac gate via the diac, and

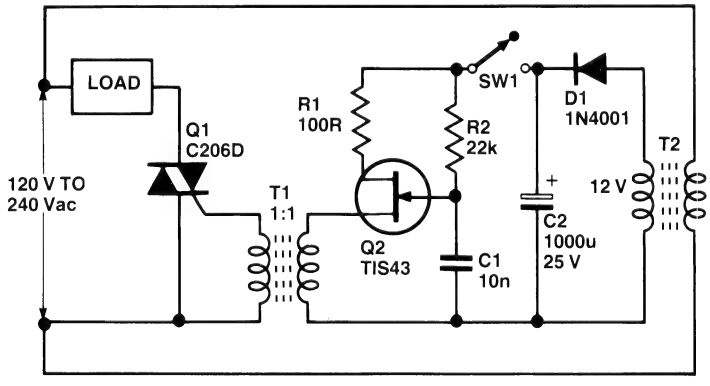

Figure 16. UJT-triggered isolated-input ac power switch.

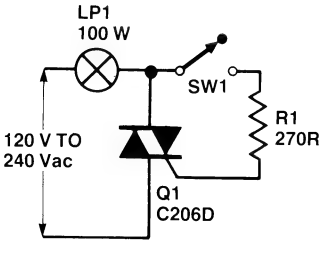

Figure 17. Line-triggered triac switch.

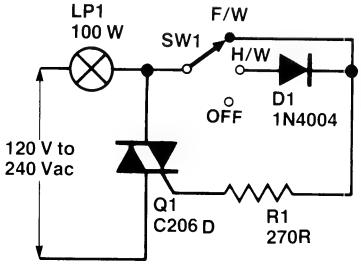

Figure 18. Three-way line switch.

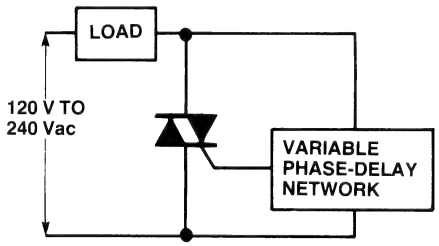

Figure 19a. Variable phase-delay 'switch'.

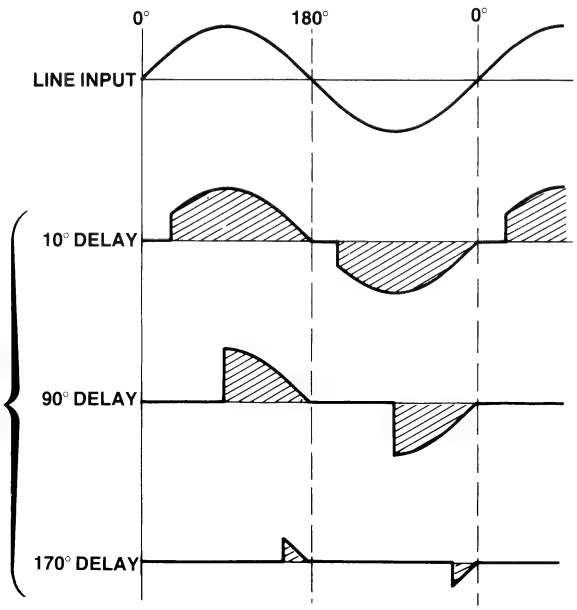

Figure 19b. Variable phase-delay waveforms.

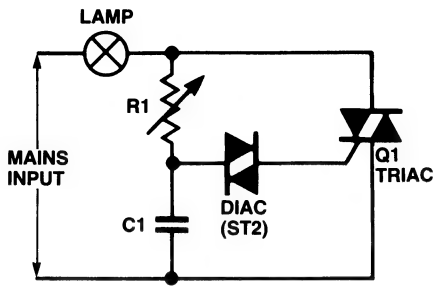

Figure 20. Basic 'diac-type' variable phase-delay lamp dimmer circuit.

each time the C1 voltage rises to 35 volts the diac fires and delivers a trigger pulse to the triac gate, thus turning the triac on, simultaneously applying power to the lamp load and removing the drive from the RC network. The mean power to the load (integrated over a full half-cycle period) is thus fully variable from near-zero to maximum, via R1.

Radio frequency interference (RFI)

You can see from the Figure 19 waveforms that, each time the triac is gated on, the load current changes abruptly (in a few micro-seconds) from zero to a value determined by the load resistance and the instantaneous mains voltage. This action generates radio frequency interference (RFI). The RFI is greatest when the triac is triggered at 90°, and is least when the triac is triggered close to the 0° and 180° 'zero-crossing' points of the mains waveform.

In lamp dimmer circuits, where there may be considerable lengths of mains cable between the triac and the lamp load, this RFI may be offensive as it will be widely radiated, interfering with radio and television receivers and other appliances. In practical lamp dimmers the circuit is usually provided with an LC RFI suppression network, as shown in Figure 21, to overcome this problem. (Note: in Figure 21 the values in brackets are applicable to 120 V mains operation.)

Zero-crossing techniques

When high power loads, such as electric heaters, are driven from triac circuitry special techniques must be used to minimise RFI. Even if the triac is used as a simple on-off switch in such applications, a 'spurt' of RFI will be generated each time the switch is turned on, and will be of maximum amplitude if the instantaneous phase delay happens to be 90° at the moment of turn-on. RFI problems can be eliminated in high-power applications by using the synchronous or 'zero-crossing' gating technique illustrated in Figure 22.

Here, a low power 12 volt dc supply is generated directly from the mains via R1-D1-ZD1 and C1. A simple zero-crossing detector network (a couple of transistors) is

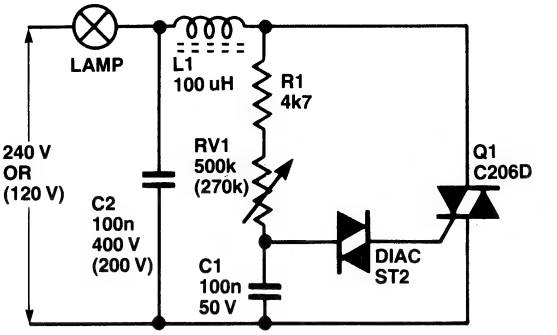

Figure 21. Practical lamp dimmer with RFI-suppression.

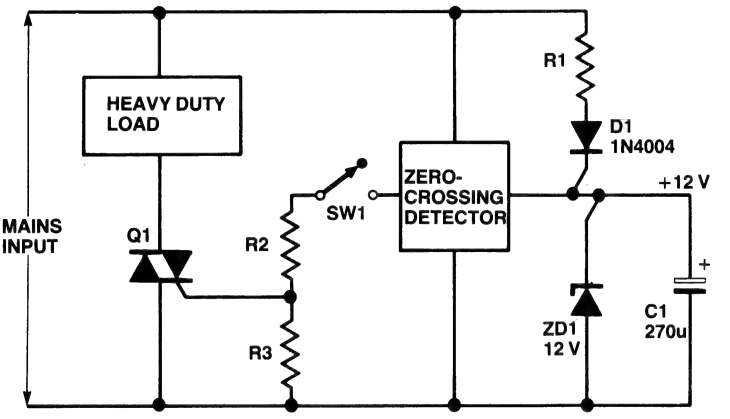

Figure 22. Basic synchronous or 'zero-crossing' mains power switch.

connected directly across the mains and controls the passage of current from C1 to SW1 in such a way that the C1 current is made available for only 5° or so on either side of each zero-crossing point of the mains waveform. Thus, if SW1 is closed, a pulse of gate current is fed to the triac at the start of each half-cycle of mains voltage, at which point the mains voltage is close to zero, so the triac always generates minimal RFI as it turns on.

The 'zero-crossing' technique can be used to provide RFI-free variable power control in high-power loads, such as electric heaters, by replacing SW1 of Figure 22 with a variable mark/space-ratio waveform generator so that a variable integral number of complete mains power cycles are alternately fed or not fed to the load.

Figure 23 illustrates the basic principle, in which the total integral period is equal to eight mains cycles. Thus, if the power is alternately switched on for four cycles and off for four cycles, the mean load power is equal to half of the total available power, and if the power is on for one cycle and off for seven cycles, the mean power is equal to only one eighth of the total available power.

In the next edition of 'Circuit File' we'll look at some practical 'zero-crossing' and integral-cycle power controllers, together with a variety of lamp dimmers and motor-speed controllers. ●

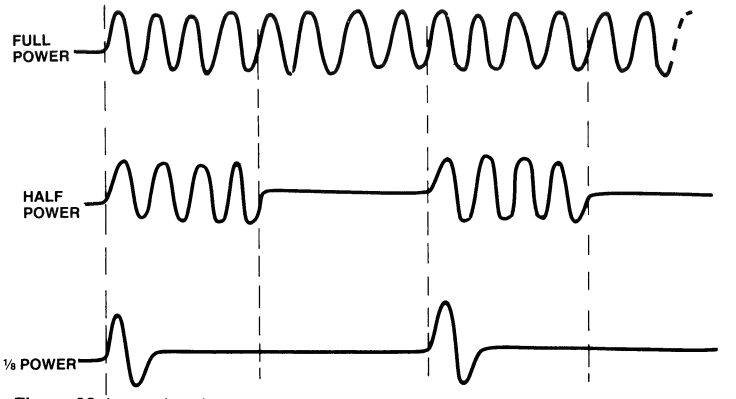

Figure 23. Integral-cycle power control waveforms.

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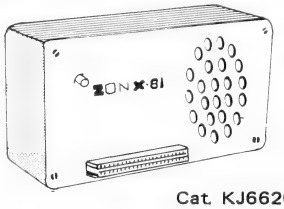

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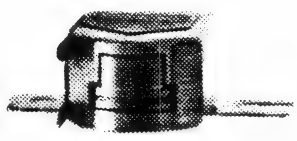

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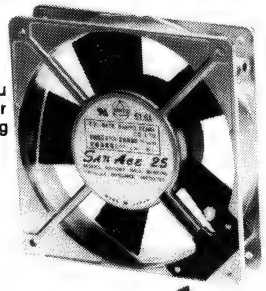

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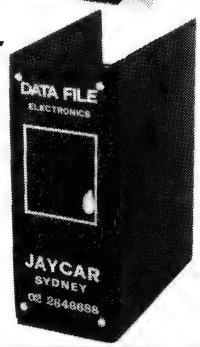

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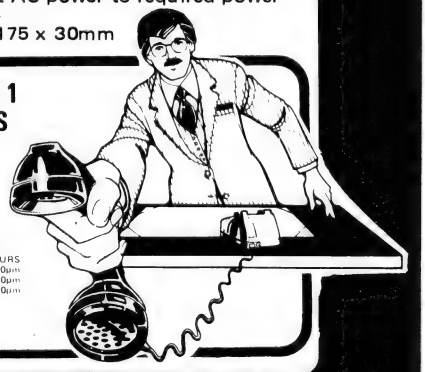


Pushbutton-operated windscreen wiper controller

Windscreen wipers always wipe either too frequently or not frequently enough. This is a corollary of Murphy's law. Vehicle engineers have spent much creative thought and effort on solving this problem since vehicles had windscreens and covered cabins. Knobs and switches abound. This one simply requires a push or two on some buttons and gives you the exact wiping frequency you need.

Geoff Nicholls
Roger Harrison

THE CIRCUIT for this project won the 'Idea of the Month' contest, sponsored by Scope Laboratories, for the September 1982 issue. A reader from Herston in Queensland, who only wished to be identified as J.D.W., submitted the circuit. It is probably one of the most intriguing circuits ever submitted for the contest. Not only that, it solved a practical problem in an elegant and intriguing way.

As the introduction says, windscreen wipers either wipe too frequently, or not frequently enough. As most late-model cars are fitted with dual-speed wipers, at high speed they're making setting-teeth-on-edge noises after half a dozen wipes in the high speed position or not getting rid of the water fast enough in the slow speed position, in any given downpour.

Vehicle manufacturers, in our opinion (and experience), have never adequately addressed themselves to the problem. Two-speed wiper systems are legion. And what driver of a vehicle with a two-speed wiper has *not* mentally labelled the two speeds 'too slow' and 'too fast'.

A 'fully variable' system has long been considered the best solution. With these a rotary control provides a variation in wiper speed from a wipe every few seconds to a few wipes per second (maximum motor speed). That's fine, but you have to mentally 'calibrate' the control. At slow wiping speeds, this is a difficult task and you spend some considerable time fiddling with the control. Inevitably, you give up and take the 'that'll do' line of least resistance.

Let us examine what happens when you're driving along and it starts to rain. First thing, the windscreen gets wet. When it gets wet enough, you want it wiped. You start the wiper and it does its job. Some interval later, the windscreen gets wet enough that you want it wiped again. *That's* the interval at which the wipers should operate. How on earth does one design a control that does that? The answer is, you don't. What you need is a controller with a 'memory'. Press a button to wipe the windscreen when it first gets too wet for you, then press it again when the windscreen next gets too wet, and have the controller repeat the wipes at the same interval. That's what the memory does — remembers the interval between the first two wipes.

What to do when the rain increases? Simply press the button again between wipes, setting a new interval. How do you stop it when the rain stops? — simple, have a stop button!

What to do when the rain decreases? Aahh — thought you'd ask that. Hit the stop button, but keep the memory going, then start the wipers again when the windscreen gets too wet, repeating the wipes at the interval between the last wipe and the new one.

That's exactly what this project does.

There's one final question to resolve, however. How long should the 'memory' be? Our correspondent set it at about 40 seconds. From observation, this seems about right. Driving in intermittent rain, we observed that the maximum interval between successive 'too wet' windscreens was about 30 seconds. During the latter half of 1982, Sydney turned on some very Melbourne-like weather — intermittent rain and shine, very light, 'patchy' rain, etc. The Editor cursed his dual-speed wiper and yearned for something better. Hence, this project.

The circuit employs half a dozen ICs, two transistors, a handful of capacitors and around 30 resistors. A relay is used to control the operation of the wiper motors.

Before going on with the construction, let us take a look at the wiper systems in modern vehicles.

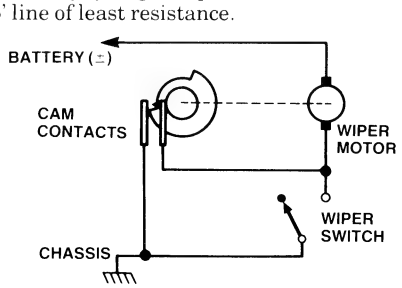


Figure 1. Self-parking arrangement for a wound field wiper motor.

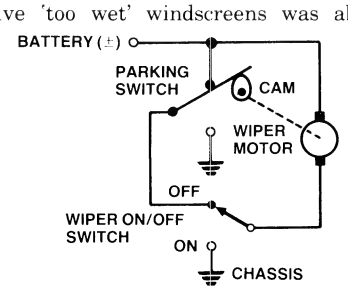


Figure 2. Self-parking arrangement for a permanent magnet wiper motor.

Wiper systems

With rare exceptions, windscreen wipers on modern vehicles are driven by an electric motor. Two motor types are employed — permanent magnet motors and wound field motors. The wiper systems are generally arranged so that the wipers are 'parked' out of the field of view when they're not in use. A cam-operated switch effects this, turning off the wiper motor only when the wipers are in the appropriate position and the supply to the motors is cut. However, the two different motor types have different braking characteristics when the motor supply is cut, so different switch schemes are used for parking.

Wound field motors simply have the supply cut when the wipers are in the appropriate position. A set of cam-operated contacts on the drive shaft effects this. Figure 1 shows how the arrangement works. The cam opens the contacts when the wipers are in the parked position. The wiper switch parallels the cam contacts. When you turn the wiper switch to the off position, the motor will continue until the cam contacts open.

Permanent magnet motors have 'dynamic braking' applied. A short circuit is connected across the motor armature when the wipers reach the parked position. The circuit is shown in Figure 2. Cam-operated changeover contacts are connected such that, when the wiper switch is set to the off position, the cam contacts short the armature. When power to the motor is cut, it becomes a generator, ▶

HOW IT WORKS — ETI-335

The best way to understand how this circuit works is to first look at the various circuit elements employed, then the step-by-step operation.

IC1 is a one-second monostable multivibrator that drives Q1. This operates the relay, RL1, the contacts of which operate the windscreen wiper motor.

IC1 is triggered via IC3d. Initially, pin 1 of this gate will be low (0 V), held down via R4 and R5. Pin 2 of IC3d will also be low initially. This is connected to the output of IC5 (pin 6) which will be at 0 V as its two inputs will initially be at 0 V.

IC2 has pins 2 (trigger) and 6 (threshold) tied together. Initially, they'll be low (below threshold), and the output (pin 3) will appear as an open circuit.

IC3a and IC3b form a flip-flop. This controls IC4, an astable multivibrator. The flip-flop inputs are pin 8 of IC3a and pin 13 of IC3b. Initially, both will be low and the flip-flop output will be low. Thus IC4 is disabled.

The output of IC4 drives the input of IC6, a dual binary counter with its two sections cascaded. Each counter has a 4-bit output. These outputs are connected to a resistor ladder network, making a 'stair step' generator. Thus, the voltage on pin 3 of IC5 rises in small 'steps' as IC4 oscillates, stopping on the last step when IC4 ceases to oscillate, providing a voltage 'memory'.

Now, let us see what happens when the WIPE button is pressed for the first time.

Operating PB1 puts a voltage pulse across R1. As C1 is discharged, this pulse appears across R4 and thus a logical high ('1') appears on pin 1 of IC3d. The output of IC3d (pin 3) will initially be high, going low (0 V) when pin 1 goes high. This triggers IC1 and its output, pin 3, goes high for a period of one second.

This turns Q1 on and the relay will be held operated for one second, causing the wiper motor to operate. The wiper will complete one wipe and, as it takes longer than one second, the relay will have dropped out by the time the wiper returns to the start position and the wiper motor will thus 'park'.

When Q1 turns on, its collector goes low and Q2 will be biased on via R15-R16. Thus, C7 will charge rapidly via R23. It can only charge to a maximum of 6.2 volts, limited by the zener diode ZD2.

After IC1 has completed its one second timing cycle and Q1 turns off, Q2 will turn off and C7 will discharge slowly via R9-R10, taking about 40 seconds. The voltage across R10 provides a small voltage which is applied to the 'control' pin (5) of IC2, which affects the threshold level at which IC2 can be triggered.

The flip-flop, IC3a-b, remains unchanged when PB1 is first pressed. Both flip-flop inputs (pins 8 and 13 of IC3) go high immediately PB1 is pressed, and thus the flip-flop output will remain low and IC4 will remain disabled.

When C7 is charged, and while it remains sufficiently charged, IC2's trigger-threshold pins (2 and 6) will be above the threshold and pin 3 will pull the cathode of D2 low (almost to 0 V). At the same time, the inverting input of IC5 (pin 2) will be held at the same voltage as is on C7 and its output will be driven to 0 V.

If the WIPE button is pressed again within 40 seconds of the first press, a voltage pulse will appear across R1 and R4, as before, but this time pin 1 of IC3d is held low by the output (pin 3) of IC2, via D2. Thus, IC1 won't trigger via this means.

However, as pin 8 of IC3a (one flip-flop input) is held low via R11-R13, the voltage pulse across R4 will appear on the other input of the flip-flop, pin 13, changing its output (pin 10/12) from low to high. Thus, IC4 is enabled and will commence to oscillate.

As IC4 oscillates, the stair step generator will rapidly drive up the voltage on pin 3 of IC5. When it reaches the same voltage as that on pin 2, the output of IC5 will immediately go high (jump to +8 V), driving pin 2 of IC3d high. Pin 3 of IC3d will then go low, triggering IC1. Thus, Q1 operates the relay once again and the wiper wipes.

When IC1 triggers this time, pin 5 of IC3a will go high and the flip-flop output will go low, disabling IC4 and stopping the count in the 4520. The output voltage of the stair step generator will thus stop at that point — providing a 'memory' of the voltage left on C7 after it discharged for the period between the first and second presses of PB1.

When Q1 turns on again, Q2 will turn on again, charging C7, raising the voltage on pin 2 of IC5 above that on pin 3. This will now drive the output of IC5 to 0 V once more, setting pin 3 of IC3d high once again, restoring the initial conditions.

After IC1 completes its timing period, Q1 and Q2 will turn off and C7 will begin to discharge again. When the voltage on C7, and thus the voltage on pin 2 of IC5, drops to that held on pin 3 by the stair step generator, the output of IC5 will go high, triggering IC1 via IC3d, as before, and the whole cycle will repeat at that interval it takes for C7 to discharge to the voltage 'remembered' by the stair step generator.

You can shorten the interval at any time by pressing PB1 between wipes.

To stop the wipe sequence, press PB2. This puts a momentary high on the 'master reset' inputs of both counters in IC6 (pins 7 and 15). All outputs are then reset low. This drops the voltage on pin 3 of IC5 to 0 V, its output then going to 0 V, setting IC3d to the initial conditions.

IC3c provides a 'power-on reset'. This ensures that the controller does not operate the wipers when the ignition is turned on and power is applied to the unit. It works like this: Capacitor C4 will be initially discharged, holding the inputs of IC3c low. When power is applied to the unit, pin 4 of IC3c will immediately go high. This drives the master reset inputs of IC6 high via R7, ensuring all the outputs are low, and also drives the threshold input of IC1 (pin 6) high via D1, preventing IC1 from operating and holding its output (pin 3) low. Thus Q1 and RL1 cannot operate.

Capacitor C4 will slowly charge via R6 and when the voltage across it reaches the high threshold (about 4 V, ±1 V) of the IC3c inputs (pins 5, 6) the output, pin 4, will go low, readying IC6 for counting. Diode D1 will now be reverse biased and IC1 will be ready for operation.

That covers the general operation, but there are a few more details you'll need to know for better understanding of its operation.

Firstly, the period of IC1 is determined by R3 and C5. The actual period is not critical, so close tolerance components are not necessary here.

The frequency at which IC4 oscillates is determined by R12, R14 and C6. This is about 2 kHz. Here too, the exact frequency is not important, it simply means that at that rough frequency, the stair step generator output steps up to the required level very rapidly.

The RC network consisting of R1-C1-R4 is there simply to provide a pulse. When PB1 is pressed, C1 will initially be discharged, so the voltage across R4 will rise instantly to 8 V. But C1 will charge fairly rapidly and the voltage across R4 will die away quickly. The RC network of R5-C3 is an integrator which 'cleans up' the pulse from PB1. Contact bounce in PB1 may prevent reliable operation of IC3d and thus IC1.

Diode D3 shorts out the back-emf of the relay coil when Q1 turns off, protecting Q1 from collector-emitter reverse voltage breakdown.

The +8 V supply is provided by a simple zener regulator consisting of R24 and ZD1. Capacitor C9 provides supply rail bypassing, as do capacitors C8 and C2.

The 'memory' interval is determined by C7 and R9. We do not recommend you vary R9 if you want to vary the memory interval. Vary the value of C7 instead.

current through the short circuit sets up a field in the armature which reacts with the permanent magnet field so as to produce a force opposing the rotation of the armature.

Connection of the wiper controller relay contact to the wiper system differs for each scheme, and this is covered later in the article.

Construction

Assembly of the project is quite straightforward. We recommend you use our pc board design. This avoids wiring errors and provides a robust mount for the parts. You can make your own pc board or buy one ready made (see the 'Shoparound' page in this issue). We'll assume you're using our pc board.

All the electronic parts are mounted on the board. The relay and two pushbuttons are mounted elsewhere, in convenient places in the vehicle. Tackle the pc board assembly first. Before commencing assembly, go over the board looking for broken tracks, small 'bridges' between tracks — particularly where they run close together and between IC pins. Also look for holes that haven't been drilled. If, or when, all is well you can tackle the assembly.

There are a total of 11 links on the board. We did this to avoid the expense of a double-sided pc board. Nine of the links are simply straight 'straps' using 22 gauge tinned copper wire (identified by dotted lines on the overlay). The other two are 'flying wire' links — one on the top side of the board (the black, snaky line on the overlay), the other underneath IC6 (shown in the accompanying photograph). Install the tinned copper wire links first. Note that one runs beneath IC5 and another beneath IC6. The flying wire links use insulated hookup wire and are installed later.

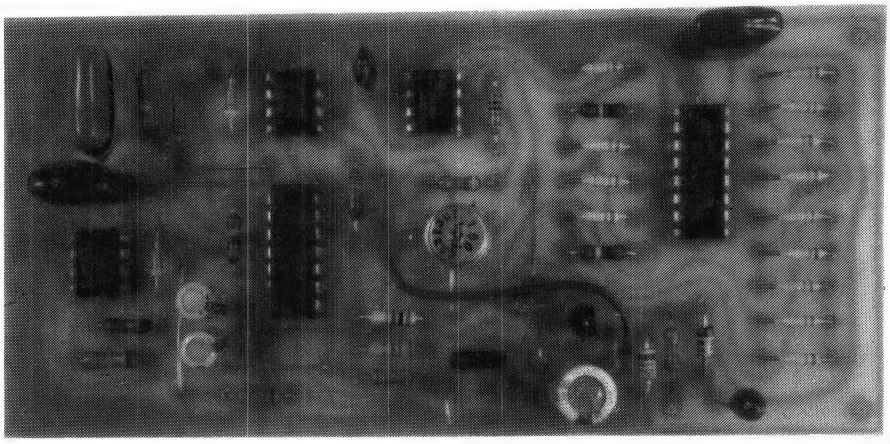
With the links in position, all the resistors can be soldered in place. The overlay has been laid out so that component placement is easily identified. Component numbers start in the top left hand corner of the board and go down, then across the board in increasing number. The last resistor (R33) is at the bottom right of the board.

Solder the capacitors in place next. Follow with the two 1N914 diodes, ZD1 (8V2), ZD2 (6V2), Q1 (BD139) and Q2 (BC557). The diodes and transistors have to be correctly oriented. Check which way round they go by looking at the component pinouts and the board overlay.

Now solder IC1, IC2, IC4 and IC5 in place. These are all in 8-pin packages. ICs 1, 2 and 4 are all 555s, while IC5 is a CA3130. Note that all ICs are oriented the same way, with pin 1 toward the 'top' of the board. Last of all, solder IC3 and IC6 in place. These are both CMOS ICs. Only handle them with your thumb and forefinger, holding the package by the ends so as to avoid touching the pins. If you're new to project assembly, a metal IC insertion tool is a great help. Solder pins 7 and 14 of IC3 first, then the other pins. With IC6, solder pins 9 and 16 first, then all the other pins. Do not use IC sockets as vibration in a vehicle can 'jog' the ICs out of the sockets.

Now you can install the flying wire links.

Connection between the board and the external components, the relay and pushbuttons, is made via a six-way terminal block. At this stage, you're going to have to work out where everything is to fit in your vehicle. You've probably already done that, anyway. You could temporarily hook things up and try it out (without connecting the relay contacts), just to see if it works and to sort out any possible troubles before finally installing the unit.



Circuit board. The completed pc board. Note that some resistors are stood on end. The pc board pattern is reproduced on page 111.

When testing it out, check that it works as described and see that the between-wipes 'memory' is at least 30 seconds. This will vary somewhat from unit to unit, because of the tolerance range of C7 and R9. That doesn't really matter, just so long as the maximum interval is about 30 seconds.

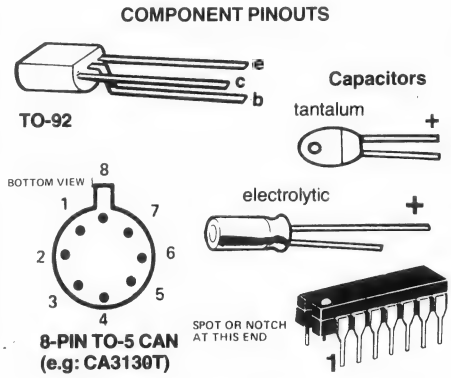
We mounted the pc board in a conveniently sized jiffy box and tucked it away under the dash. A 50 x 90 x 150 mm box will comfortably accommodate the board. Mount the six-way terminal block on the outside and inscribe the box with the A-B-C-etc terminal designations. The WIPE and STOP buttons can be mounted in any convenient position on the dash — either by drilling holes in the dash or mounting them to a box or bracket which is then affixed to the dash.

For the pushbuttons, you'll find the larger variety better to use, not the miniature ones. Both PB1 and PB2 are momentary-contact (SPST) types. Dick Smith Electronics stocks a suitable type, catalogue S-1199, as do Altronics (catalogue no. S 1080) and Electronic Agencies (catalogue no. SE0252). All these have a 15 mm square button (you can have any colour you like, so long as it's red) and require a 12 mm mounting hole.

The relay, as originally suggested by J.D.W., can be mounted in the engine compartment. This means you don't hear it going 'click-clock' all the time when the wipers are in use. Any standard 12 V relay with a set of changeover (SPDT) contacts rated at 5A at least can be used. If you can find one with lugs that take automotive-type slip-on spade connectors, so much the better.

Don't forget to wire D3 across the relay coil. You could, if you like, mount D3 on the six-way terminal block. (No, we didn't forget to include this on the board. It's just that, as the board was getting pretty cramped, it was more convenient to mount D3 off the board.)

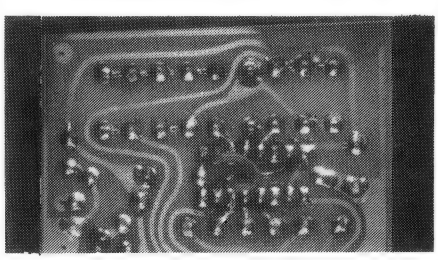
Secure the relay firmly with a bracket. Use medium or heavy duty hookup wire (10 x 0.2 mm or 24 x 0.2 mm) to wire in the relay and pushbuttons.



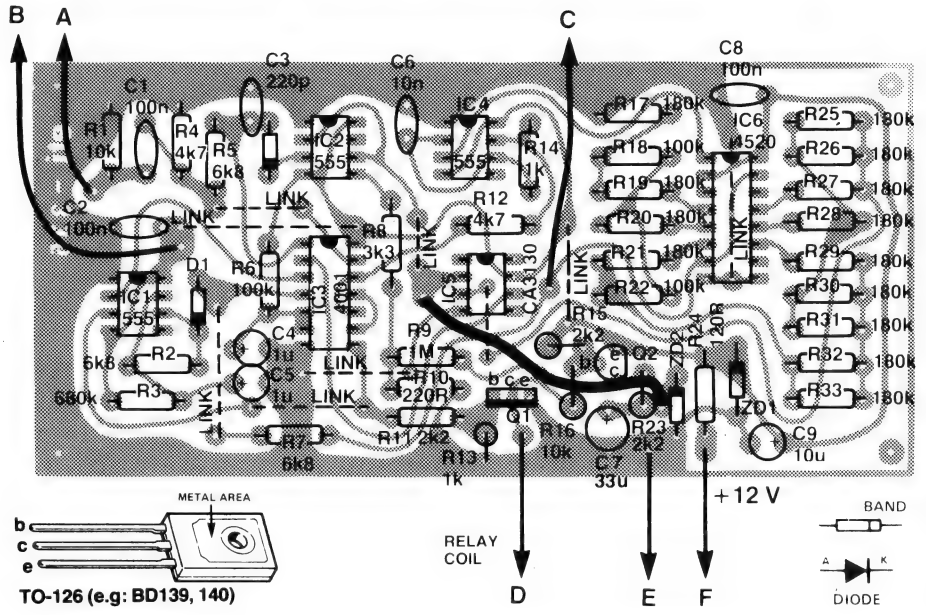
Wiring it to the wiper system

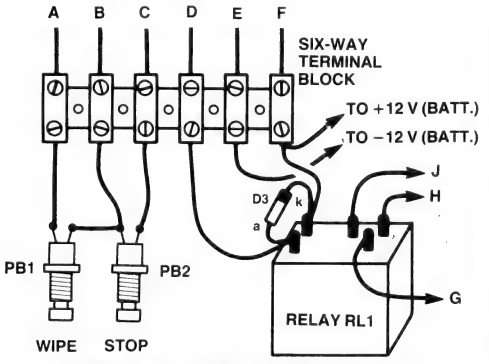
The general wiring schematics for single- and dual-speed wiper systems employing wound-field motors are shown in Figures 3 and 4. In each case, the *normally open* relay contacts of the controller are wired in parallel with the parking switch. Trace the wiring between the wiper motor and the switch. For the type of system shown in Figure 3, the switch will have two wires running between it and the wiper motor. It should be an easy matter to sort out which wire is which and to connect the relay contacts accordingly.

The dual-speed system shown in Figure 4 will have three wires running from the wiper switch to the motor. Grounding lead 1 should set the wipers going in 'high speed', grounding leads 2 or 3 should set the wipers going in 'low speed'. You can connect the normally open relay contacts (G and H) from 2 or 3 to chassis, or from 1 to chassis. In the latter case, you can operate the wipers right up to maximum speed.

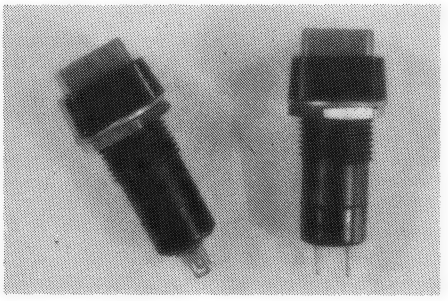


Underside link. Rear view (copper side) of the board showing the link between pins 6 and 10 of IC6.





Wiring. The board is wired to the pushbutton, relay and supply via a terminal block. The +12 V goes via an ignition-switched fuse (−12 V for +ve earthed cars). The relay contacts connect to wiper system.



Buttons. The two pushbuttons we used. Miniature types are not recommended.

PARTS LIST — ETI-335

Resistors ..... all 5%, ½W unless noted

R1	10k
R2, 5, 7	6k8
R3	680k
R4, R12	4k7
R6, 18, 22	100k
R8	3k3
R9	1M
R10	220R
R11, 15, 23	2k2
R13, R14	1k
R16	10k
R17, 19, 20, 21, 25-33	180k
R24	120R

Capacitors

C1, 2, 8	100n ceramic
C3	220p ceramic
C4	1u/10 V axial electro.
C5	1u/10 V tant.
C6	10n ceramic
C7	33u/10 V tant.
C9	10u/10 V tant.

Semiconductors

IC1, 2, 4	555
IC3	4001
IC5	CA3130
IC6	4520
ZD1	8V2 1 W zener
ZD2	6V2 1 W zener
Q1	BD139
Q2	BC557
D1, D2	1N914, 1N4148
D3	1N4001, 1N4002 etc.

Miscellaneous

ETI-335 pc board; RL1 — SPDT relay with 5 A contacts and 180 ohm (or greater) coil (e.g: Dick Smith S-7125, or similar); PB1, PB2 — momentary contact pushbuttons (e.g: Dick Smith S-1199, or similar); 6-way terminal block; box to suit — 50 x 90 x 150 mm (if necessary); hookup wire, nuts, bolts etc.

A dual-speed permanent magnet system is illustrated in Figure 5. Here, the wire from the wiper switch to the parking contacts (3) is cut at X-Y and the wiper controller's *normally closed* contacts (J and G) connected across the cut. The normally open contact (H) is connected to chassis. If you need maximum wiper speed when using this system, simply use the wiper switch as you normally would.

In most instances, the chassis (earth) contact for the wiper switch is made through the body of the switch. Those systems which include a washer system where the washer is activated by pushing the wiper switch will have an extra wire for the washer. Some systems, usually found on British cars, are arranged to operate independantly of an earth (i.e: do not use the vehicle chassis as a return lead) so that they may be fitted to either positive or negative earthed electrical systems. In such cases, you'll find a fifth wire extended from the wiper switch to the wiper motor, as indicated in Figure 5.

The installation of this wiper controller in no way alters normal operation of the wipers via the wiper switch installed in the vehicle. ●

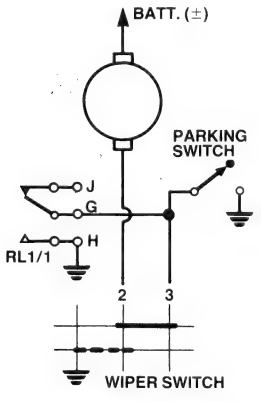


Figure 3. Wiring the relay contacts to a single-speed wound field wiper system.

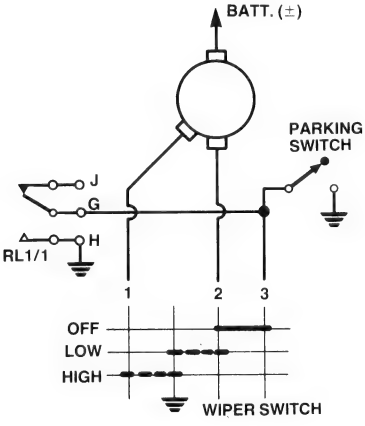


Figure 4. Wiring the relay contacts to a dual-speed wound field wiper system.

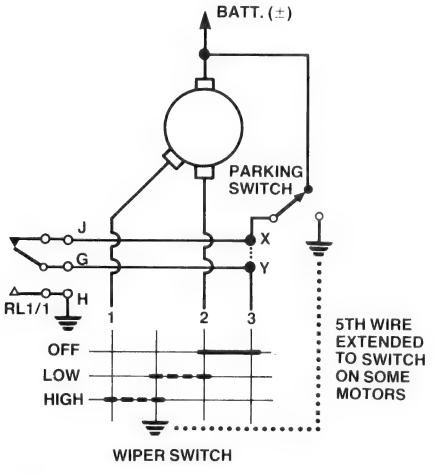


Figure 5. Wiring the relay contacts to a dual-speed permanent magnet wiper system.

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Professional unit — cost a fraction of similar built-up units.

This project is "so easy to construct", virtually all components mount on one single PCB, ensuring success even for the "not so experienced" constructor.

Use of the latest LSI circuitry ensures impeccable performance from the completed unit. This is further ensured by our use of top grade components.

NOTE: (Altronics use only the specified intersil LSi — beware of inferior kits that do not conform to the original design.

Frequency measurement to 500mHz (with optional Prescaler) in 3 ranges — 0—10MHz, 0—50MHz, 10—500MHz ⋆ 4 gating times — 0.01, 0.1, 1, 10 seconds.

Period measurement for accurate low frequency counts, 4 ranges — 1, 10, 100, 1000 input cycles ⋆ resolution 0.1us.

High Input Sensitivity — 10MV to 30MHz. 100MV at 50MHz @ 1MOHM Input impedance, 200MV @ 500MHz @ 75 OHMS input impedance.

Accuracy — typically better than 0.005% uncalibrated.

Exclusive Altronic Kit Features

- ⋆ IC sockets provided throughout
- ⋆ low aging 10.000 MHz XTAL.
- ⋆ Genuine Fairchild High Brightness FND 507 display's.
- ⋆ Quality ABS plastic case — deluxe front panel.
- ⋆ Complete kit as specified by EA includes instructions, all cables and every last nut, bolt and washer.

K2500. . . . . $119.50

DECIMAL POINT FOR K2500

READ FREQUENCY DIRECTLY IN MHz and PERIOD IN US.

K2502. . . . . $7.50

PRESCALER FOR K2500

ALLOWS FREQUENCY MEASUREMENT TO 500MHz

K2501. . . (essential option) . . . $26.00

FUNCTION GENERATOR

(with digital display)

Sine, triangle and squarewaves : 15Hz — 250KHz.

The most essential piece of test gear (second only to a good multimeter) on any hobbyist's bench is some kind of audio signal generator. This design utilizes the latest circuit techniques to produce stable, low distortion waveforms.

A truly versatile unit at a bargain price.

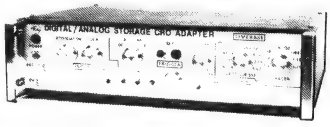
- ⋆ 4 digit frequency readout (eliminates tiresome dial calibration) —typical accuracy ± 2%.
- ⋆ 3 overlapping ranges x1, x10, x100.
- ⋆ 600 OHM Nominal Output — continuously variable 3MV—2.5V P—P.
- ⋆ Distortion — sinewave : less than 0.7% @ 1KHz.
- ⋆ Linearity — triangle wave : better than 1% @ 1KHz.
- ⋆ Squarewave rise time — 6V/uz maximum output.
- ⋆ Amplitude stability — better than 0.1dB on all ranges.

With the exception of the display all components mount on a single PCB making this kit suitable for all constructors.

K2505. . . . . $85.00

ANALOG / DIGITAL STORAGE CRO ADAPTER

(See EA Nov 1980 and March 1981).



Unit enables indefinite storage of non-repetitive waveforms at a fraction of the cost of conventional storage CRO's. National semiconductors A—D/D—A conversion techniques allow analog signals up to 100KHz to be stored ⋆ two channels while in digital mode ⋆ positive and negative edge triggering ⋆ AC/DC/HF and LF rejection ⋆ timebase tracer for accurate frequency measurement ⋆ accurate down to 1.9Hz Analog mode — 1us Digital Mode ⋆ delayed trigger 10us-1s ⋆ sensitivity — 160MV P—P @ 1 MEG (Analog)* standard TTL and CMOS levels 3-15 volt supply (Digital).

The features of this unit are to numerous to list, yet is simple to operate.

Be assured of quality with an Altronics Kit.

1. Genuine National A—D conversion chips not second sourced dropouts.
2. All IC sockets provided (27 total — you pay no more)
3. Low capacitance coax and a full metre of rainbow cable.
4. Full instructions and every last nut, bolt and washer.
5. Deluxe mini rack cabinet.

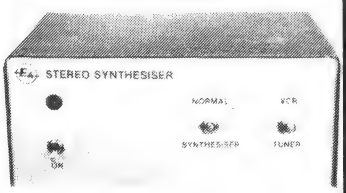
K2600. . . . . $189.00

STEREO SYNTHESIZER FOR TUNERS & VCR's

(See EA Sept. 1982)

Synthesize realistic stereo from virtually any monophonic source by simply connecting this unit between the source and your stereo amplifier.

ENJOY THE PLEASURES OF STEREO SOUND



- ⋆ Quality Phillips MN3001 (not second source dropout)
- ⋆ Provision for 2 different signal sources.
- ⋆ Selection of either source via front panel switch.
- ⋆ Normal or stereo sound selection.
- ⋆ Complete kit includes all hardware, cables etc., even solder.

Important ⋆ beware of Kitset suppliers who sell this kit for less ⋆ you get less!!.

K5810. . . . . $55.00

TRANSISTOR TESTER

Electronics Australia Project. Tests Bipolar Transistors, Diodes, Fets, SCR's and PUT's. Excellent service aid for the hobbyist and serviceman. Complete kit and instructions.

K 2525 . . . . . $19.75

DIGITAL CAPACITANCE METER

Electronics Australia Project. Measures capacitance of both polarized and non polarized capacitors from 1 picofarad to 99.99 microfarads in 3 ranges.

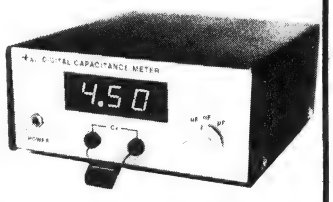
Check values of unmarked capacitors, especially those little trimmers that are never coded.

Select precise values for filters and timing networks with ease.

⋆ ⋆ ⋆ ⋆ **Exclusive to Altronics** ⋆ ⋆ ⋆ ⋆

Each kit includes precision measured capacitors for accurate calibration of each range.

K2520. . . . . $49.50



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POWER SUPPLIES

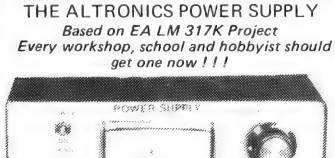
OUT BEST SELLING POWER SUPPLY KIT EVER

3—32 volt output at 1 amp UNDER $40

THE ALTRONICS POWER SUPPLY

Based on EA LM 317K Project

Every workshop, school and hobbyist should get one now ! ! !



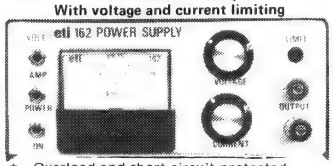
- ⋆ Fully projected from thermal runaway and short circuits.
- ⋆ Voltage and current metering.
- ⋆ To—3 regulator plus powerfin heatsink.
- ⋆ Fully documented, every last part included.

K3200. . . . . $39.95

ETI 162 BENCH SUPPLY

1.3 — 30V @ 1 Amp

With voltage and current limiting



- ⋆ Overload and short circuit protected.
- ⋆ Voltage and current metering.
- ⋆ Regulation — better than 0.2% zero to full load
- ⋆ Hum and noise on output — less than 1MV at full load.
- ⋆ LED indication of current limit.

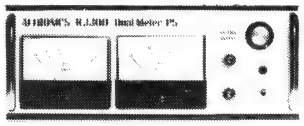
Exclusive — fully S.E.C. Certified Mains Transformer supplied.

If you're considering buying this kit from your local supplier or one of our competitors — first ring and ask them if the mains transformer is S.E.C. certified to ASC126 — chances are that it won't be.

So why not give us your order? An Altronics Quality Kit speaks for itself and with our overnight Jetservice we guarantee to deliver to your door faster than your local supplier.

K3205. . . . . $49.50

2-32 VOLT 5 AMP POWER SUPPLY



Following in the steps of our K 3200 power supply comes **BIG BAD BROTHER!** Based around the national LM338K variable regulator this supply offers exceptional value for money.

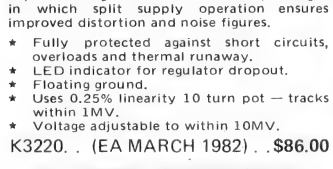
- ⋆ 2-32 Volt Output of 7 Amps.
- ⋆ Peak Currents of 7 Amps.
- ⋆ Protected from both short circuits and thermal runaway.
- ⋆ Continuous voltage adjustment.
- ⋆ Dual Metering enables Continuous Voltage and Current Display.

The Handiest Power Supply Kit Ever for Workbench, Laboratory etc.

K 3300 $129.50

DUAL TRACKING POWER SUPPLY

± 1.3 to± 22V @ 2 AMPS : + 5V @ 0.9 AMPS



The ideal power supply for the audiophile experimenting with linear OP amp designs in which split supply operation ensures improved distortion and noise figures.

- ⋆ Fully protected against short circuits, overloads and thermal runaway.
- ⋆ LED indicator for regulator dropout.
- ⋆ Floating ground.
- ⋆ Uses 0.25% linearity 10 turn pot — tracks within 1MV.
- ⋆ Voltage adjustable to within 10MV.

K3220. . (EA MARCH 1982) . . $86.00

ALTRONICS

For address, phone number and despatch details see our advertisement on page 45.

A 'float' charger for NiCad batteries

This NiCad battery charger provides a happy medium between fast chargers and constant-current chargers. It's cheap, simple to build and will bring a battery to full charge from complete discharge in 12 hours — then keep it there. And your NiCads are safe from overcharging damage.

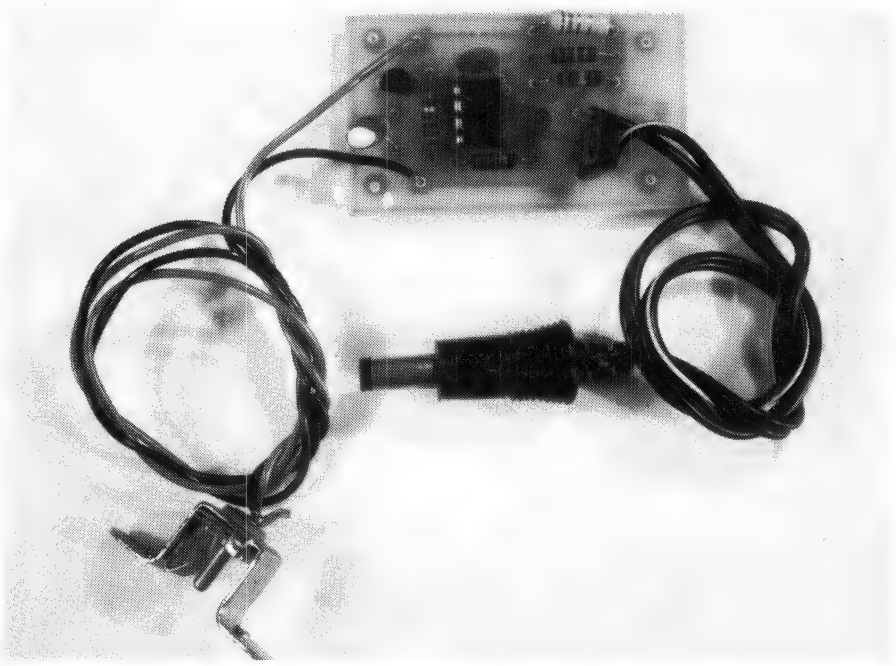
Jonathan Scott

AS YOU MIGHT INFER from the great range of chargers available and the number of projects describing them appearing in this and other magazines (should you ever read one, accidentally) there is more to charging NiCads than meets the eye. NiCads are rather finnicky things to deal with in that they basically require fairly continuous attention. The very best conditions are simply *use:* if you discharge and charge a set of NiCads once a week or so, they deliver hundreds of cycles quite happily.

However, this is not the case in many typical applications. They may be unused for weeks or months in the flashgun of your camera or as battery backup in instruments. They may, on the other hand, be left trickle-charging endlessly and never discharged more than 10%, as is the case in a torch used for two minutes every week. Neither form of disuse is good. You can get fast chargers, such as the ETI-563, or the recommended controlled current source type which will charge at the ten-hour rate, or very low current trickle charge types such as are incorporated in some electric toothbrushes or small torches. Trickle chargers are safe in that the NiCads are not actively harmed no matter how long you leave them connected, but the cells take three days to recover a full charge. The controlled current sort are able to charge a cell right up in about 14 or 15 hours, but will upset the cells in about 24 hours if left on. Fast chargers are damn quick, and fairly safe if they are the type which turn off and you set them for the correct time, but are more costly and bulky.

Hence we present yet another alternative. This project will bring a set of cells up to full charge from complete discharge in about 12 hours and then automatically drop to a trickle whenever the charging is done. This means full recovery in half a day with safety from overcharging damage. Hence the title, 'Float Charger'.

The circuit presented here is specifically designed for penlight size batteries ('AA') and is arranged to charge four cells in series, which is the number generally found in portable cassette players, etc. You're not locked-in to this set of circumstances however. You can charge different numbers of cells of amp-hour capacities between 250 mAh (¼ Ah) and 1 Ah simply by selecting the values of three resistors according to Table 1. The project will charge up to four cells from a 10 volt supply. For each additional cell, the supply needs to be increased by 1.5 V. i.e: six cells need 13 volts supply.



Simplicity plus! A handful of components, a 30 x 50 mm pc board . . . and no complications.

Although the project will charge cells of up to 4 Ah capacity it will work at full rate only on cells up to 1 Ah, but this is not a serious problem as most small appliances and backup systems use quarter or half amp-hour types.

The project can be incorporated inside a piece of equipment or it can be built into some dedicated charger at very little cost (under $10) and will run off any power supply of 10 to 22 volts (according to what's required). e.g: a plugpack, car battery, power supply, etc. In addition, there are no controls or presets to adjust at all. Some chargers of this type require calibration against a digital meter or similar, but this one is born calibrated. It may be fabricated on its own pc board or incorporated in the power supply of something you are building.

Construction

Construction of this project is largely left up to you as far as boxes and connectors go because of the many possibilities you have open. The prototype was left unencapsulated, and has been fitted with a plugpack receptacle on the input end and a similar plug on the output as it has been designed to go between a small cassette player and a plugpack originally provided to charge the cells inside the player. A car cigarette lighter plug could just as easily be fitted to allow use in a car. If you do not intend to use a carefully polarised input connector, a diode in series with the input is a good idea as the unit will be damaged if exposed to reverse polarity.

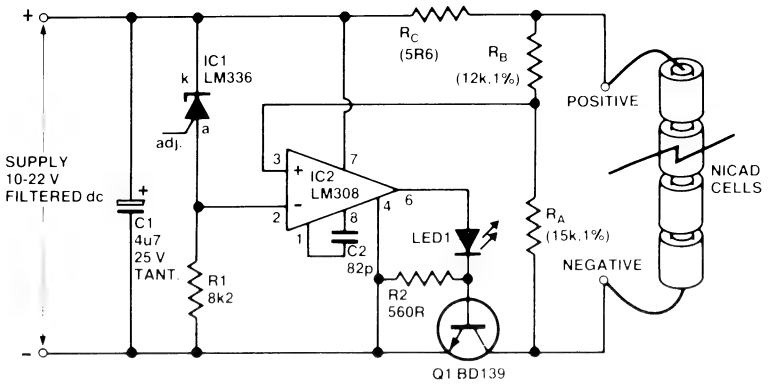
The first thing to do before constructing the project is to select values for the three resistors R_A, R_B and R_C according to Table 1, given the size (Ah capacity) and number of the cells to be charged. If your application has a number of cells not covered in the table, use the formulae given there to find values. ▶

HOW IT WORKS — ETI-268

The 'ideal' charger for NiCad batteries is a precision voltage source in series with a fixed resistance — where the voltage source is a little above the battery terminal voltage when fully charged. Thus, when a discharged battery is connected, the charge current is maximum, reducing to a 'trickle' when the battery is fully charged. That's what this project has been designed to do. It makes use of a low cost precision reference element, an LM336, and a comparator driving a series-pass transistor to control the charge current applied to the batteries.

The precision voltage reference, IC1, looks to 'the outside world' as a zener diode. The 'adj.' terminal permits adjustment of either the terminal voltage (over a very small range) or the temperature coefficient (how the terminal voltage drifts with variation in temperature). The 8k2 resistor, R1, provides current for IC1 which produces a fixed potential of between 2.390 V and 2.590 V below the positive supply rail at its anode. This is fed to pin 2, the inverting input, of the 308 (IC2) which is here arranged as a comparator.

The non-inverting input of IC2 (pin 3) is fed by a voltage that depends on the sum of the terminal voltage of the cells being charged and the current fed to them. Three resistors — R_A, R_B and R_C — sample the cell terminal voltage and charging current, providing a fixed sum of these variables. The output of IC2 drives the base of Q1 via LED1. Q1 controls the charging current fed to the cells. The sum of the voltage drops across R_C and R_B is maintained at the same voltage as that across IC1. As the terminal voltage of the cells rises with charging, the voltage drop across R_C will



decrease, but the voltage drop across R_A/R_B will increase. The ratios have been set so that the drive to the base of Q1 decreases as cell voltage rises.

The LED between the base of Q1 and the output of IC2 serves two purposes. It provides the voltage offset required between the IC's output and the negative supply rail as the 308 cannot drive its output right down to the negative rail; and secondly, it gives an indication that the charger is operating. (You can check that the load is correctly connected by looking for an increase in intensity when connection to the cells is made). Resistor R2 keeps Q2 turned off when required and ensures that there is some current flowing in LED1 even when the load draws no current. Capacitor C1 removes any hash from the supply which might upset the 308 in a noisy environment. Capacitor C2 provides compensation for IC2. Neither capacitor is critical in value, but C1 should be a tantalum type if you intend to run the charger in harsh electrical environments such as a car or near RF equipment. A 308 was chosen for IC2 as it has a very low offset voltage and a high input impedance.

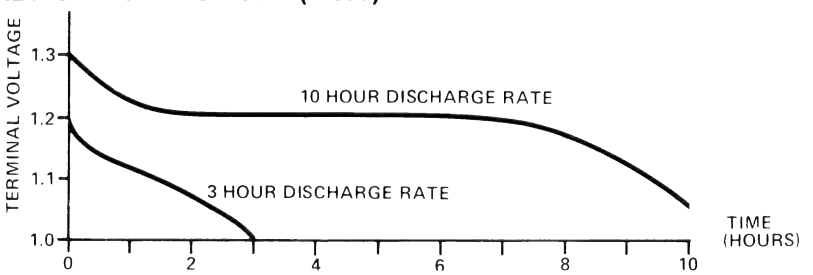
The output of the 308 is current-limited internally and since the load current is equal to the beta of Q1 times the current sourced to its base, the output is current-limited to a value of around 300 mA or so. If the charger output is likely to be shorted (or if the possibility exists), Q1 should be placed on a small heatsink, for safety's sake. Under normal operating conditions charging penlight (AA) cells, Q1 does not require a heatsink. Should you wish to upgrade the unit for higher charging currents, a Darlington-pair device should be substituted for Q1, with suitable heatsinking attached.

THE NICKEL-CADMIUM CELL (NiCad)

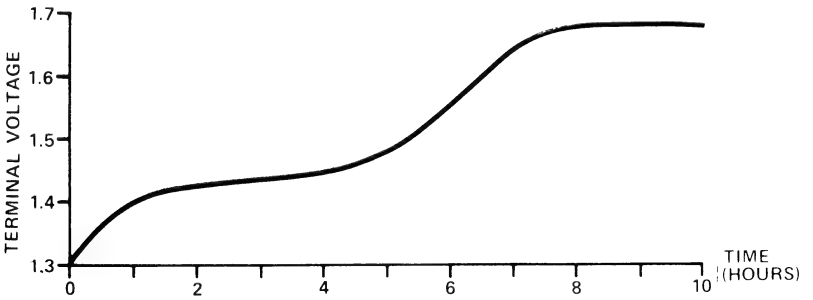
NiCad cells use a potassium hydroxide electrolyte. In a typical unit the positive and negative plates are both perforated steel. The positive plate is filled with nickel hydroxide, the negative plate with finely divided cadmium mixed with a little iron to prevent it flaking and losing porosity. The electrolyte has a specific gravity of 1.15-1.2, depending on the type of service. It does not undergo any chemical change during discharge. Very little electrolyte is needed and the positive and negative plates are very closely spaced.

NiCad batteries are made in a wide variety of sizes and amp-hour capacities. Miniature ones for use in cameras, calculators etc up to large heavy duty types similar to car batteries. They may be operated over a wide temperature range — similar to that of lead-acid batteries. At low temperatures, the amp-hour capacity does not diminish as much as with lead-acid batteries. However, the electrolyte may freeze.

As NiCad batteries may be sealed, they can be used in any position. The no-load terminal voltage of a nickel-cadmium cell is typically 1.3-1.4 volts. This drops to about 1.2 volts under load, and to about 1.1 volts when discharged. As the electrolyte does not change during discharge (as it does in lead-acid batteries), the number of amp-hours obtained from a NiCad battery is much less affected by the discharge rate than are lead-acid batteries.



Going down. Typical discharge characteristics of NiCad cells.



Juicing up. Typical charging characteristics of NiCad cells.

As NiCad batteries can be made quite small, and can be recharged, they are eminently suitable for use in portable electronic equipment such as calculators, tape recorders, hand-held transceivers, camera flash units etc. They can withstand considerable vibration, are free from sulphating or similar problems, and can be left in any state of charge without ill effect.

Charging should be done with a constant-current charger. The charging rate for the quickest charge should be no more than 1.5 times the 10 hour discharge rate. Most manufacturers recommend a charge rate and a trickle or 'float' charge rate and this is best adhered to.

PARTS LIST — ETI-268

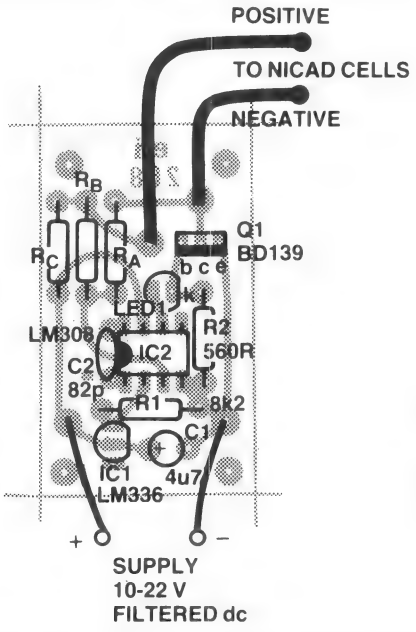
Resistors ..... all ½W, 5% unless noted
R1 ..... 8k2
R2 ..... 560R
R_A ..... 15k, ¼W, 1% see Table 1
R_B ..... 12k, ¼W, 1% see Table 1
R_C ..... 5R6 see Table 1

Capacitors
C1 ..... 4u7 or 10u 25 V tantalum
C2 ..... 82p ceramic

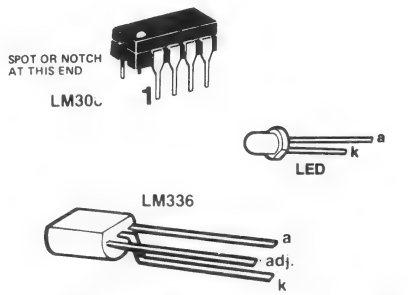
Semiconductors
IC1 ..... LM336
IC2 ..... LM308, uA308 (or /A)
LED1 ..... RL209R miniature red LED, or similar
Q1 ..... BD139

Miscellaneous
ETI-268 pc board; supply input and charger output connectors to suit (see text); small heatsink (see text) if necessary; hookup wire etc.

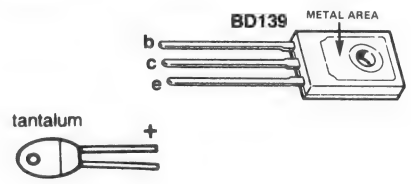
Price estimate
$7 — $8



Overlay. Showing component positioning on the pc board. Components are placed on the non-copper side of the board. Watch the orientation of C1, IC1, IC2, Q1 and LED1. Check these with the component pinouts.



IC1. The LM336 is available in a plastic case, similar to the TO-92 style and marked LM336Z or LM336BZ, or in a metal case, like a TO-39 style and marked LM336BH. The plastic-cased variety is most common and cheaper. Above is the pinout, showing lead connections.



Next, fit the components to the pc board according to the overlay, being sure to get the ICs, LED, transistor and tantalum capacitor the correct way around in each case. If you intend to charge cells larger than penlight size, or there is a possibility of more than momentary shorting of the output, leave enough length in the leads of Q1 and fit a small heatsink, about 2 cm^2 in area.

Mounting holes have been marked on the pc board if needed so it can be attached to a chassis.

Once assembled, fit the wires and connectors. A small clear or amber plastic pill bottle makes an excellent case for this project if no particular location is necessary. The wires can be knotted and slipped through two small holes in either end.

Turn on

Apply power and see that LED1 illuminates. If not, switch off and check the LED orientation and the supply polarity. Fix any faults and start again. Then connect the cells. A small increase in brightness of the LED should be noticeable as you make the circuit.

Note that you cannot normally judge correct operation by inserting a current meter in series with the batteries as this upsets the sensing by virtue of the slight voltage drop across the meter terminals. Instead, measure the voltage across R_C, and divide by the resistance to determine current flowing. ●

TABLE 1

(A)

Cell capacity	R_C
250 mAh	12R
500 mAh	5R6
1000 mAh	3R3

(B)

No. of cells	R_A	R_B	Supply (min.)
2	1k5	10k	10 V
4	15k	12k	10 V
6	68k	27k	13 V
10	56k	12k	19 V
	¼W,1%	¼W,1%	

CALCULATION OF VALUES

Make R_B a convenient value below 100k

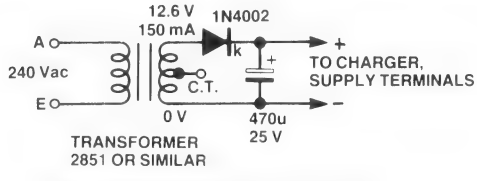
$$\text{then, } R_A = R_B \left(\frac{C}{1.754} - 1\right)$$

where C is the number of cells.

Go through the routine, reselecting a new value for R_B, if R_A does not come out within one or two per cent of a common value.

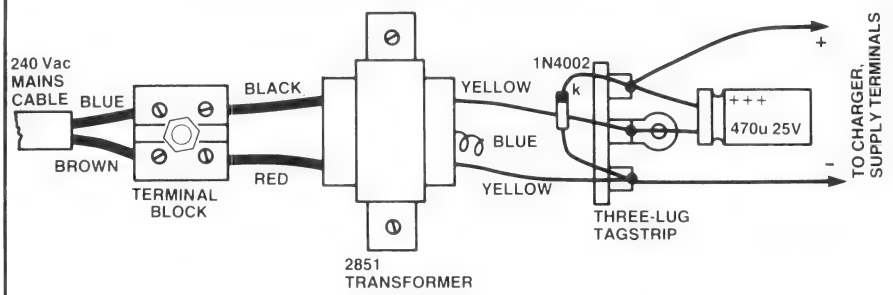
$$R_C = \frac{3}{I_{nom.}}$$

where $I_{nom.}$ is the nominal 10 hour charge rate.



CIRCUIT OF A SUITABLE POWER SUPPLY

SUGGESTED CONSTRUCTION OF POWER SUPPLY



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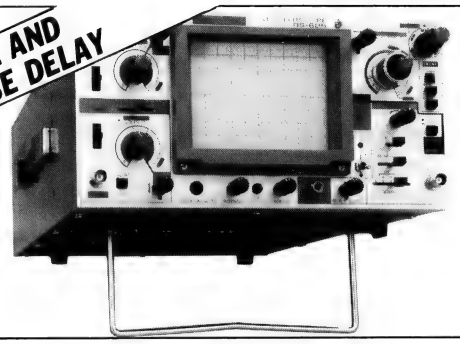
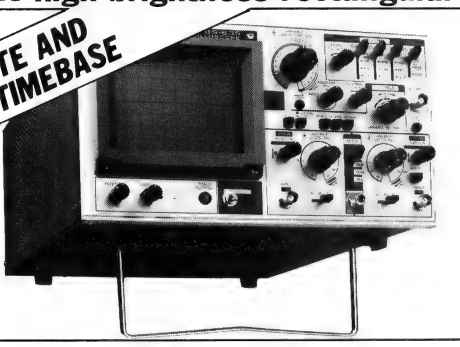


- 7.7nS risetime
- Single sweep
- Trigger delay
- TV sync
- X-Y, dual, chop, add, subtract etc.

45MHz/1mV

BS625 $990.00

ALTERNATE AND DELAYED TIMEBASE

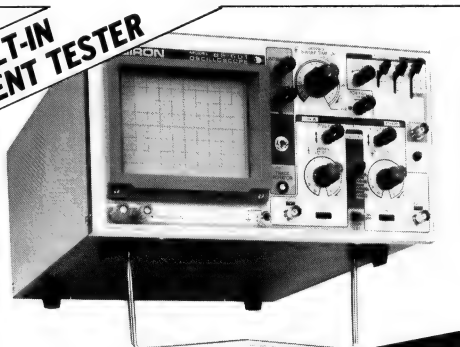


- 21 range timebase
- 100mS-1 uS trigger delay
- Front panel trace rotate
- X-Y, dual, chop, add, subtract etc.

35MHz/1mV

BS635 $790.00

BUILT-IN COMPONENT TESTER



- Check components on screen
- 19 range timebase
- Triggerable to over 30MHz
- 17nS risetime

New low price for popular AARON scope

$485.00

20MHz/5mV

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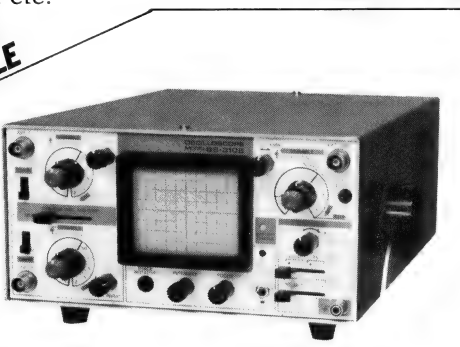

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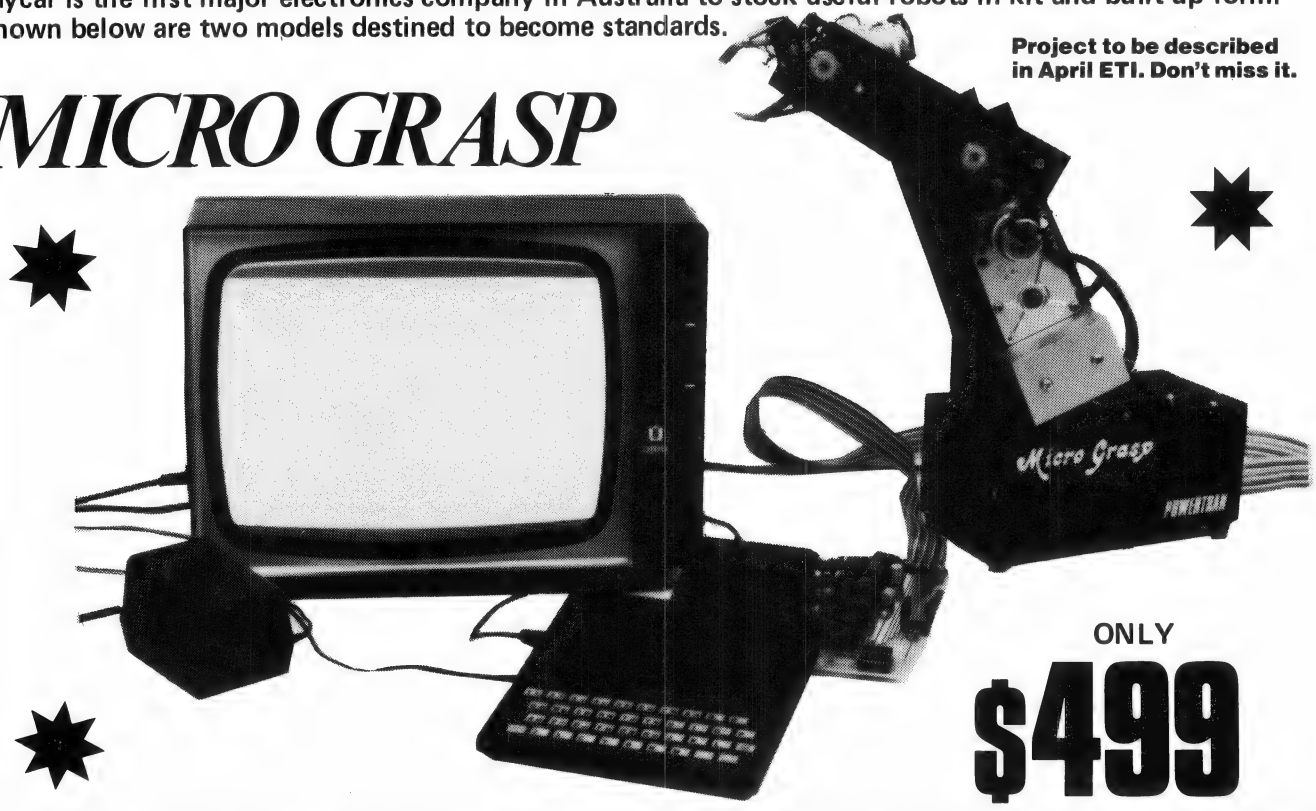

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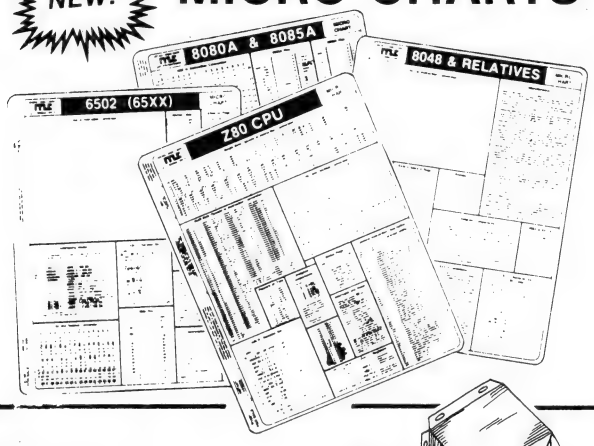

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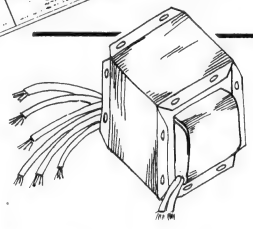

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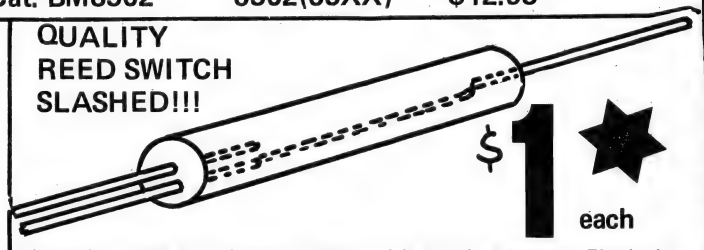

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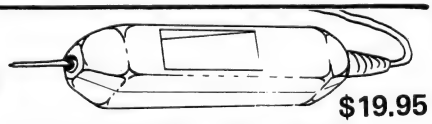

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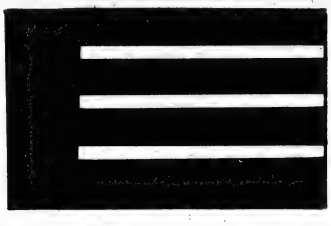

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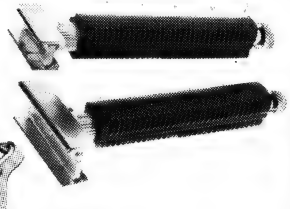

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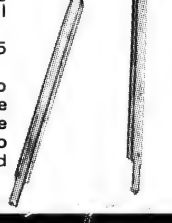

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MORE microprocessors are used in real time process control than in any other application. They are embedded in instruments, motor cars, household appliances, machines and robots. Process control computers use digital and analogue interface circuits to transfer program commands to machinery and to read signals fed back from transducers.

Constructing and using this general purpose interface card will introduce you to the world of real time process control and enable your Apple to interface to 'the real world'. You can use this interface to connect your Apple to computer peripherals, electronic instruments and science experiments. Possible applications include: controlling a Turtle robot, automatic control of a slot car, driving a printer, reading a digital voltmeter, monitoring a weather station or recording the output of a potentiometer connected to a physics experiment.

Design

The card will interface the computer to eight digital inputs, eight digital outputs, one analogue input, and one analogue output. Detailed specifications are given in Table 1. The interface circuitry is based on a Motorola 6821 peripheral interface adaptor (PIA). The PIA is designed to connect digital signals to a Motorola 6800 microprocessor. The 6502 microprocessor, used in the Apple, has the same external buss structure as the 6800, allowing Motorola peripheral chips to be used in 6502-based systems. The internal architectures of the two microprocessor families differ considerably, however.

Both processor families use memory mapped input/output; that is, all peripheral interface registers are addressed as if they are memory locations. Memory load and memory store instructions are used to read from and write to interface registers; special input/output instructions are not required. Address decoding for the six internal registers is done by the PIA.

On the peripheral side, the PIA has sixteen bi-directional signal lines, which can be individually selected as input or output lines, and four control lines. The input/output lines are split into two 8-bit bytes, known as the A-side and the B-side.

Timing differences between the clock signals at the processor and the clock signals at the peripheral connector (Figure 1), a result of the unusual design of the Apple II, will cause data loss and must be compensated for. The Apple's master oscillator generates a bi-phase clock signal (C01 and C02 in Figures 1 and 2). Phase two of the master clock is fed to the processor which produces a second bi-phase clock (P01 and P02) for internal processor timing.

Data is latched into all chips on the falling edge of phase two and ten nanoseconds later data is removed from the buss. The master clock signal (C02), used by the peripheral interface circuits, leads the processor clock signal (P02) by thirty nanoseconds (Figure 2). A direct consequence of this time difference is data loss during read cycles because the PIA starts to remove data from the buss twenty nanoseconds before the processor latches. Data written to interface registers is not affected. Some of the interface control signals have been delayed to minimise this time differential.

Signals from the peripheral connector are buffered (Figure 3) in order to minimise the resistive and capacitive load placed on the peripheral buss by the interface card. The A-side digital outputs are buffered to increase drive capacity.

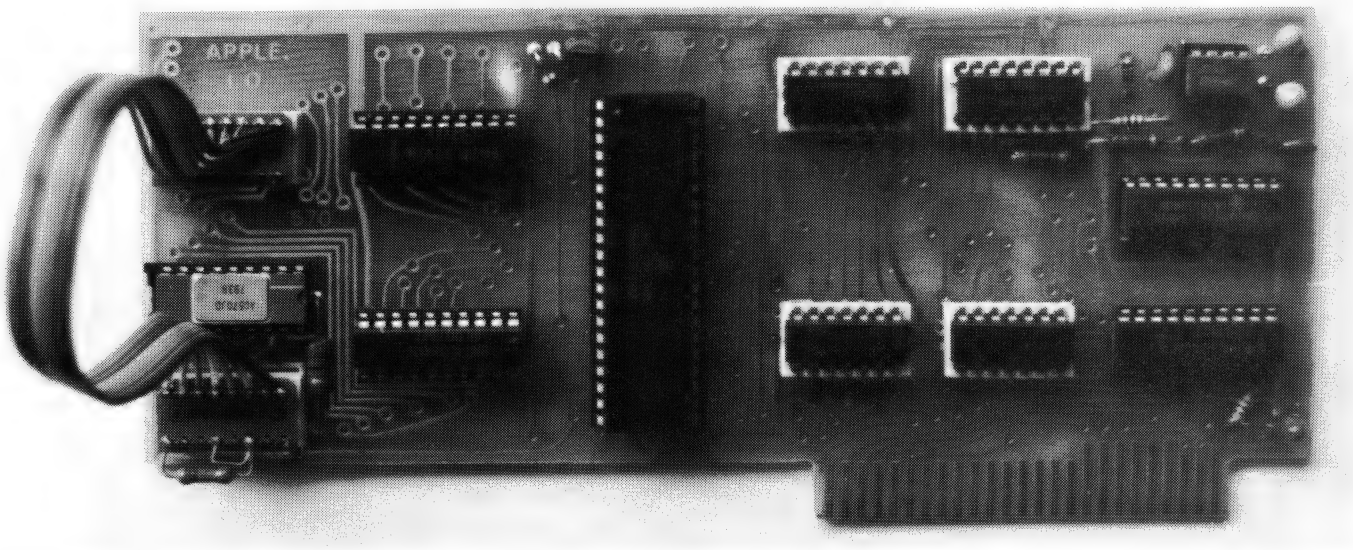
TABLE 1. SPECIFICATIONS

Normal setup

- eight digital outputs, TTL level; sink 40 mA, source 10 mA.
- eight digital inputs, TTL level; maximum load 20 uA.
- one analogue output (8-bit D-A), 0-10 V, 5 mA maximum.
- one analogue input (8-bit A-D), 0-10 V, 3k minimum impedance.

Setup variations

- digital outputs can be used as inputs.
- maximum analogue output is variable between −10 V and +10 V.
- analogue input range can be changed to −5 V to +5 V.



The B-side of the PIA is used for digital and analogue input. A control signal selects which signal, digital or analogue, is on the B-side buss. When analogue input is selected, the digital input buffer is disabled and analogue-to-digital conversion initiated. The analogue-to-digital converter (ADC) signals that conversion is complete using a second control signal and places the result on the B-side buss. The ADC can be changed from unipolar (+ve voltages) to bipolar (+ve and −ve voltages) operation by removing a link.

A multiplying digital-to-analogue converter (DAC) is used to produce the analogue output. The DAC data register is addressed independently of the PIA. The magnitude of the analogue output is determined by the product of the digital value stored in the data register and the reference voltage; hence the name *multiplying* DAC. ▶

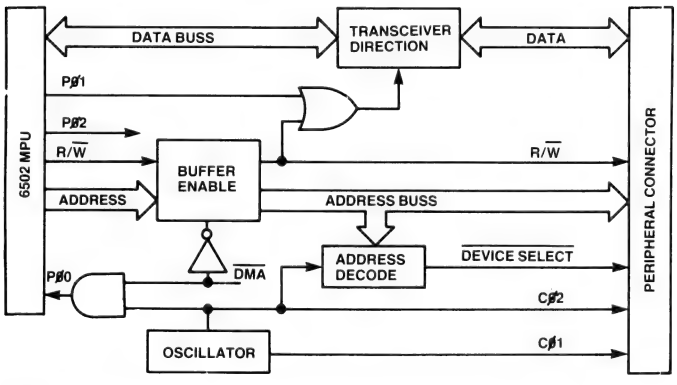


Figure 1. Block diagram of Apple II microcomputer showing processor and peripheral clock signals.

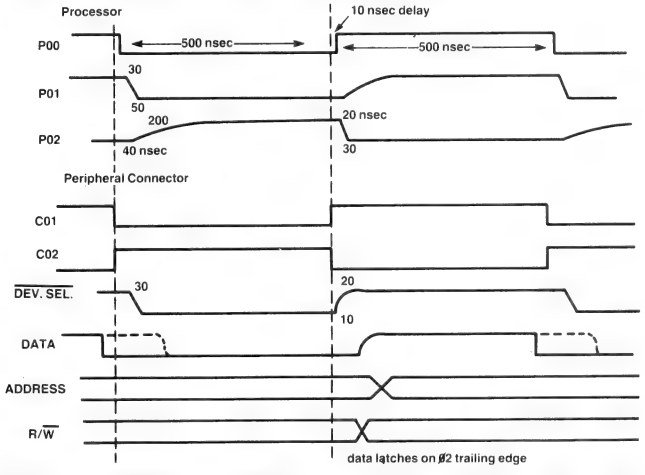


Figure 2. Comparison of processor and peripheral connector timing showing 30 nanosecond mismatch between trailing edge of clock 02 at processor and peripheral connector.

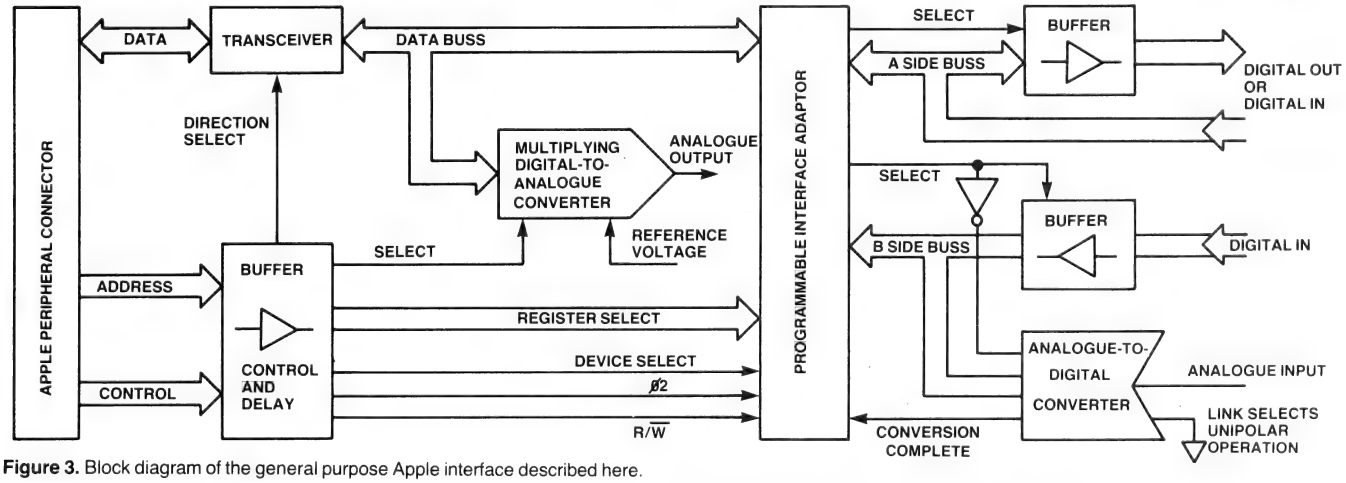
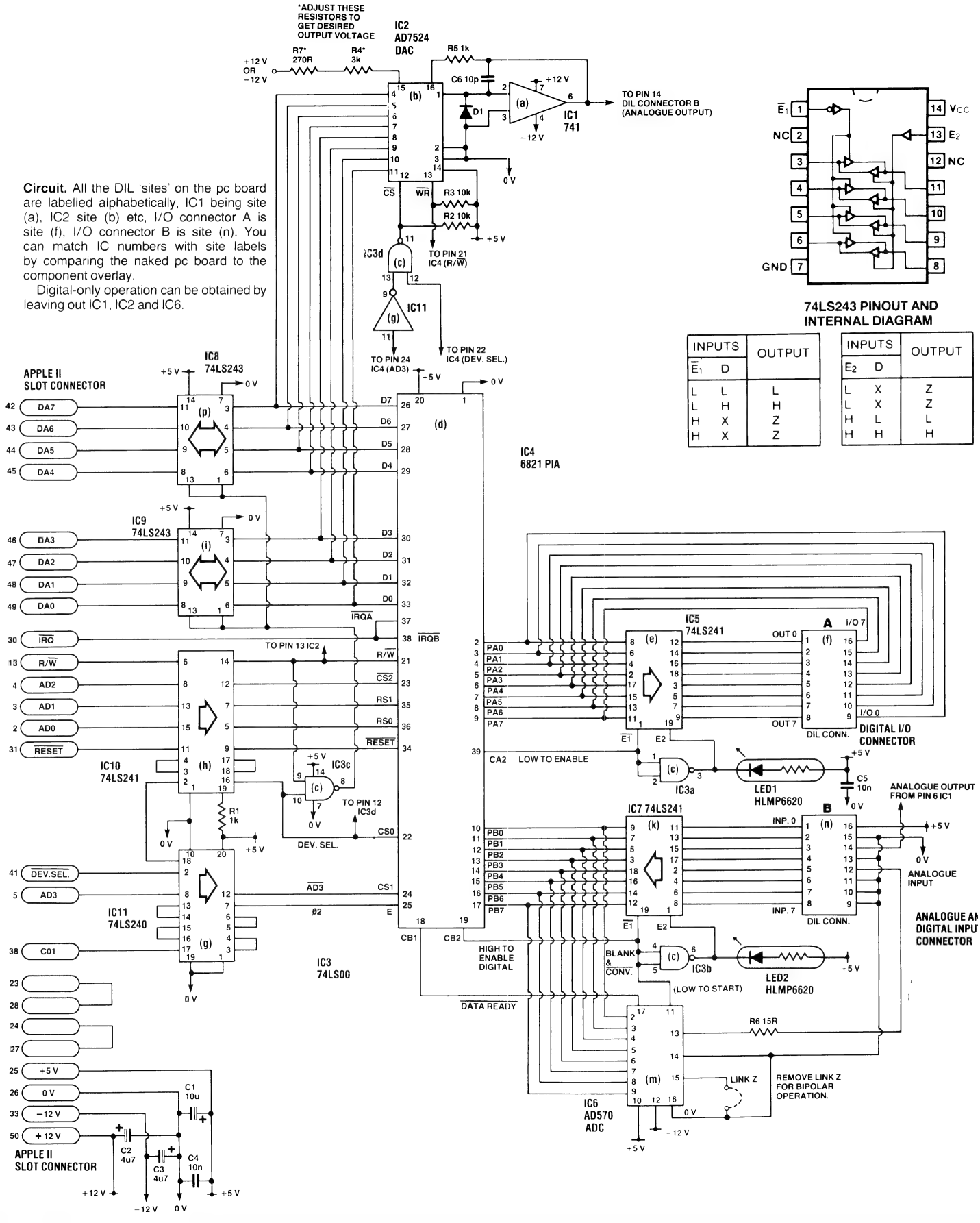


Figure 3. Block diagram of the general purpose Apple interface described here.



74LS243 PINOUT AND INTERNAL DIAGRAM

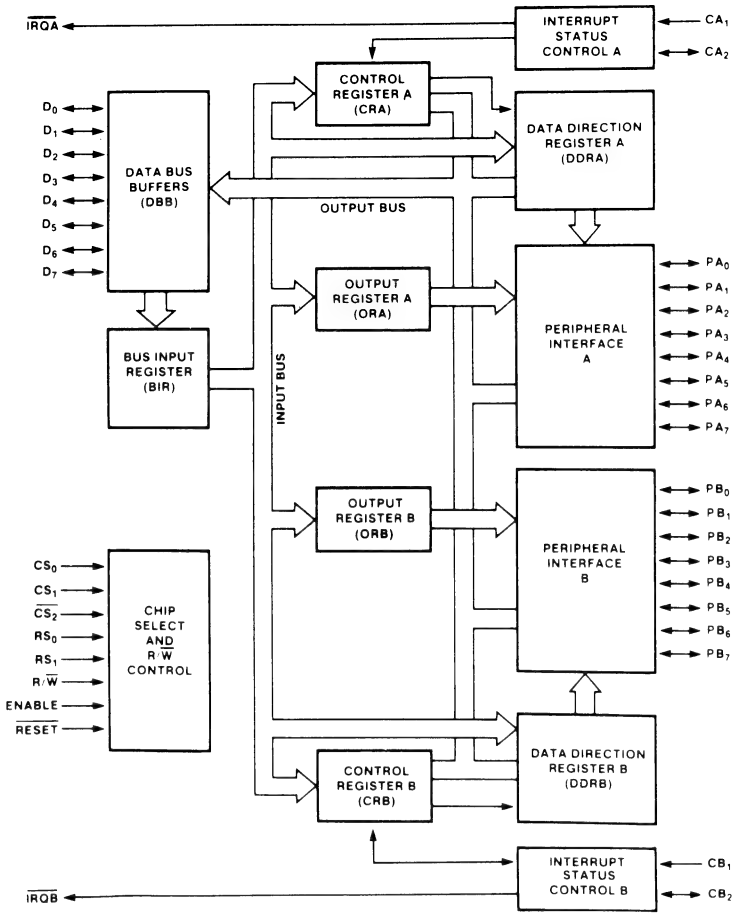
INPUTS		OUTPUT
$\overline{E}_1$	D	
L	L	L
L	H	H
H	X	Z
H	X	Z

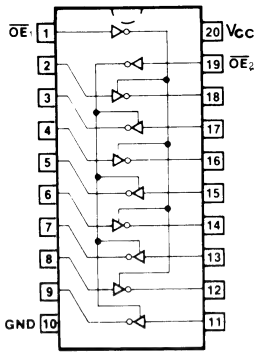
INPUTS		OUTPUT
E_2	D	
L	X	Z
L	X	Z
H	L	L
H	H	H

Circuit. All the DIL 'sites' on the pc board are labelled alphabetically, IC1 being site (a), IC2 site (b) etc, I/O connector A is site (f), I/O connector B is site (n). You can match IC numbers with site labels by comparing the naked pc board to the component overlay.

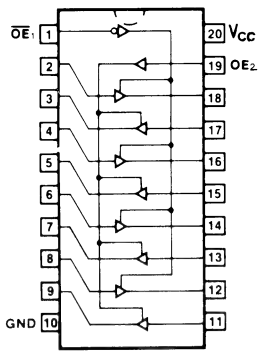
Digital-only operation can be obtained by leaving out IC1, IC2 and IC6.

6821 PIA INTERNAL DIAGRAM





74LS240 PINOUT AND INTERNAL DIAGRAM



74LS241 PINOUT AND INTERNAL DIAGRAM

TRUTH TABLES

'S240, 'LS240

INPUTS			OUTPUT
$\overline{OE_1}$, $\overline{OE_2}$	D		
L	L		H
L	H		L
H	X		Z

'S241, 'LS241

INPUTS				OUTPUT
$\overline{OE_1}$	OE_2	D		
L	H	L		L
L	H	H		H
H	L	X		Z

H = HIGH Voltage Level L = LOW Voltage Level X = Immaterial

Z = High Impedance

HOW IT WORKS — ETI-654

This should be read in conjunction with the text under 'Design'. The object is to transfer signals to and from the Apple's data buss via the peripheral interface adaptor (PIA), a 6821 — IC4. The PIA is controlled by a set of control signals available at the Apple peripheral (or slot) connectors.

Sixteen memory locations are set aside for each peripheral connector. A read or write to one of these locations will assert device-select; this signal is used to enable the address decoding circuits on the interface card. Device-select (pin 41 of slot connector) is delayed by a series of cascaded buffers in IC10 and IC11 to synchronise it with phase two (02) of the processor clock.

Address buss signal three (AD3, pin 5 of slot connector) selects the AD7524 DAC (IC2), and de-selects the PIA when asserted. Thus the analogue output buffer register is at address 8 relative to the base address of the card. The PIA registers are at addresses 0 — 3, and are selected using address buss signals zero and one (AD0 — AD1, pins 2 and 3 of the slot connector), via IC10.

Peripheral connector signal C01 (pin 38, slot) is delayed and inverted by a string of cascaded buffers in IC11 to produce a synchronised enable signal for the PIA (E, pin 25 of IC4). All data latching occurs on the trailing edge of the enable signal (phase two).

The PIA has six internal registers: two control registers, two data registers and two data direction registers. These registers are split into two groups of three: the A-side registers and the B-side registers. As the operation of the two groups is almost identical, only the A-side is discussed.

The direction (input or output) of individual signal lines is selected by setting the corresponding bit in the data direction register (DDR). Setting the DDR bit to one enables data output and clearing it to zero enables data input. Output data is stored in the data register and input data is read from the data register. The data direction register and the data register share the same memory location. The register accessed during a read or write is determined by the value of bit two in the control register — a one selects the data register. The control register is also used to enable the two control lines, CA1 and CA2, and to monitor their status.

The A-side, digital output buffer (IC5) is enabled when CA2 (pin 39, IC4) is low. When CA2 is high the buffer is tri-stated and the A-side can be used for digital input. CA1 is unused.

Control line CB2 (pin 19, IC4) is used to select the B-side digital inputs by enabling IC7 when high, or analogue input by disabling IC7 and requesting analogue-to-digital conversion when low.

The analogue-to-digital converter (IC6, the AD570) used successive approximation to calculate the digital value. When conversion is requested the most significant bit of the internal digital register is set (value: hex 80) to provide the first approximation. This value is converted to analogue using an internal DAC for comparison with the analogue input. The comparator determines whether the DAC output is greater or less than the analogue input. If the output is less the bit is left on, but if it is more the bit is turned off. This process is repeated, bit by bit, until all eight binary-weighted bits in the internal register have been compared. The final value in the register is the digital equivalent of the analogue signal within plus or minus half of the least significant bit.

When conversion is complete the ADC outputs are enabled onto the B-side buss and CB1 (pin 18, IC4) is asserted low. The converter can be operated either in unipolar mode, by connecting pin 15 to 0 volts, or bipolar mode by removing the link (link Z). CB2 must be raised to reinitialise the chip and to disable the outputs before another conversion can be requested.

Data is latched into the 8-bit multiplying digital-to-analogue converter (IC2, the AD7524) when the chip select line (pin 12) goes high. The voltage reference (pin 15) is connected to outputs 1 and 2 via an internal binary-weighted resistor ladder network.

If a bit in the data register is set, the respective ladder resistor is connected to output 1; if it is cleared, the resistor is connected to output 2. Thus, the current out of output 1, into a low impedance load, is the analogue equivalent of the digital value multiplied by the reference voltage. This current signal is converted to a voltage by the 741 operational amplifier (IC1).

The table here gives the analogue-to-digital and digital-to-analogue conversion values.

Digital Signal (hex)	Analogue Output (volts)	Unipolar Analogue Input	Bipolar Analogue Input
0	0	0	−5
80	−0.5 Vref	+5	0
FF	−Vref	+10	+5

Construction

A double-sided, through-hole plated pc board has been used for this project, partly to keep the size within bounds so that it fits within the Apple II case. Hence, unless you have access to through-hole plating facilities, you will have to purchase a ready-made pc board from one of the suppliers listed in the Shoparound page in this issue.

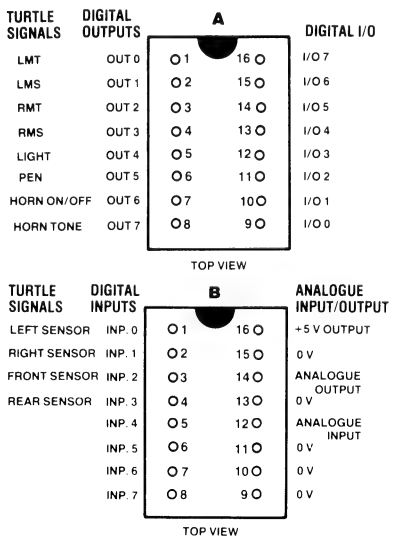
Before soldering any components onto the circuit board check that it will plug into a peripheral-connector base in the Apple. If it is oversize, trim the excess width off with a file, being careful to maintain alignment between edge connector tracks and base pins. Then check the board for any shorts between edge connector tracks.

Now you can commence assembly of the board. Install link Z first, followed by the resistors and diodes. Double check the orientation of the diodes before soldering them. If you are using IC sockets put these in next. If not, put the ICs in. Insert them into the board one at a time and solder two diagonally-opposite pins. Check the seating of the socket/IC and that all pins are through the holes before soldering the remaining pins. All ICs except the PIA have the same orientation. Next, put the two DIP connector bases in and finish with the capacitors. The orientation of the tantalum capacitors is important. If you used IC bases plug the ICs in now.

Having completed the construction, visually check the card for missed solder joints, solder bridges (particularly under the DIP connectors), dry joints and incorrectly oriented components. Clean excess flux from the soldering using a little methylated spirits and an old toothbrush.

Installation and testing

The card has been designed for automated testing using the test cable, shown in the drawings, to connect interface outputs to interface inputs. Two test programs are given; one to test digital input/output and one to test analogue input/output. All values printed out by the programs are in decimal, unless otherwise indicated. The analogue test program requires the analogue input range and the analogue output range to be the same: 0 — 10 volts.



Connectors. The A connector pinout has buffered digital outputs on pins 1 to 8 and unbuffered digital I/O on pins 9 to 16 (all PIA A-side I/O). The B connector pinout has buffered digital inputs on pins 1 to 8 (PIA B-side) with the analogue input and output, +5 V supply and 0 V lines on the other side. The 'standard' Turtle control signals are also shown.

Plug the test cable into the input/output connectors and insert the card into peripheral slot 2 of the Apple II. The card will work in any slot, but the test programs are written for slot 2. When facing the keyboard, the components go towards the right, and the input/output connectors towards the keyboard. *Never insert or remove the card while power is on.*

Switch the Apple power supply on. The Apple should come up and display a message on the screen. If it doesn't, turn the power off immediately and recheck the board. If it still fails to come up, use a logic probe to determine which buss signal is pulled permanently high or low.

Once the Apple is up, load and run the digital test program. The two LEDs on the interface card should flash ten times with the Apple's bell ringing every time the lights come on, indicating that the processor can address the PIA's control registers. The invisible character in line 535 of the test program is the bell character, control G. Then, an ascending sequence of numbers will be written out, read in and compared. The error information can be used to diagnose any faults. You may have to convert the numbers to binary, by hand, to see what is happening.

Once the digital section has been checked, the analogue test program can be run. This program writes, reads and displays various analogue values. These can be compared visually to check digital-to-analogue conversion accuracy. Expect differences between input and output of plus or minus one bit due to conversion range and linearity differences. The DAC output can be adjusted to the desired maximum value by changing the reference resistors. No adjustment is available for the ADC. It has been factory trimmed, so its accuracy must be checked with a digital voltmeter.

Programming

Programming consists of initialising the PIA and transferring data to and from the card. PIA-register contents are read using memory load instructions, and written using memory store instructions. In high level languages like BASIC, PEEK and POKE functions are used. The address of a register is calculated, using the data in Tables 2 and 3, by adding the register address to the interface address.

Slot Number	Hex	Address Decimal
0	C080	−16256
1	C090	−16240
2	C0A0	−16224
3	C0B0	−16208
4	C0C0	−16192
5	C0D0	−16176
6	C0E0	−16160
7	C0F0	−16144

Table 2. Interface address (A) — address of DRA for each slot.

Address	Function
A+0	Data Register A or DDRA
A+1	Control Register A
A+2	Data Register B or DDRB
A+3	Control Register B
A+8	Analogue Output

Table 3. Register address — address of the interface registers relative to the interface address (A).

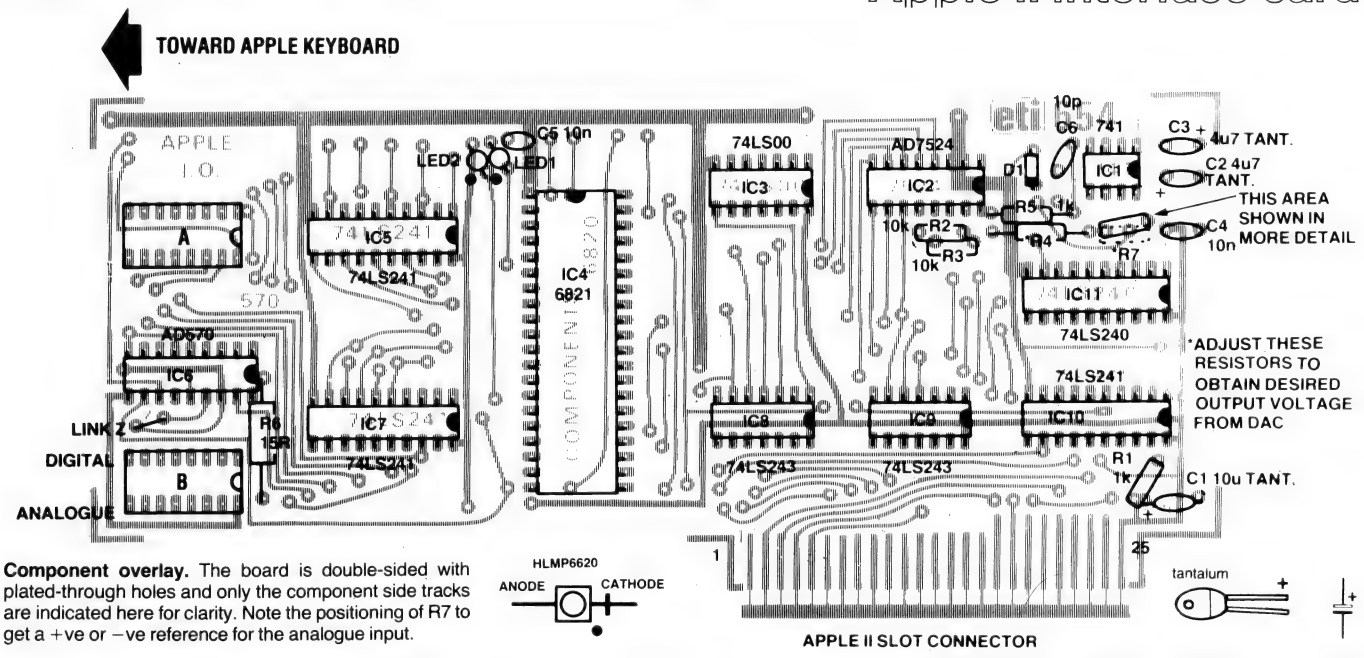
When the system is powered up, all PIA registers are cleared and all input/output lines are selected as inputs. Before data can be transferred through the interface the PIA must be initialised. The steps involved are:

1. Select the data direction register by clearing control register bit 2.
2. Write data to the data-direction register to select the direction of the individual signal lines.
3. Select the data register and enable any buffers by writing the desired bit pattern to the control register.

The data register can now be written to and read from. Data written to inputs will be ignored and data read from outputs will be the output value.

Side	Function	Control register bit settings
A	Select data direction register	b2 = 0
	Select data register	b2 = 1
	Enable output buffer	b5 = b4 = 1, b3 = 0
	Disable output buffer	b5 = b4 = b3 = 1
B	Select data direction register	b2 = 0
	Select data register	b2 = 1
	Enable digital input	b5 = b4 = b3 = 1
	Request A/D conversion	b5 = b4 = 1, b3 = 0
	Enable A/D complete interrupt	b1 = 0, b0 = 1
	Disable interrupt	b1 = b0 = 0
	Conversion complete	b7 goes high, reset by reading B-side data register

Table 4. Programming the PIA control registers.



Component overlay. The board is double-sided with plated-through holes and only the component side tracks are indicated here for clarity. Note the positioning of R7 to get a +ve or −ve reference for the analogue input.

Details of the effects of control register settings are given in Table 4. On the A-side, bit 2 selects the data register and bits 3, 4 and 5 enable the digital-output buffer. On the B-side, bits 0 and 1 enable the 'analogue-to-digital-conversion-complete' interrupt, bit 2 enables the data register, bits 3, 4 and 5 select analogue or digital input and bit 7 indicates 'conversion complete'.

Programming digital input/output

The A-side is set up as digital output lines by writing decimal 225 to the data-direction register and setting bits 2, 4 and 5 of the control register.

```
10 REM  Initialise A-Side as digital Outputs
20 POKE A+1,0        Select DDR
30 POKE A,225        Select lines as outputs
40 POKE A+1,52       Select DR and Enable Buffer
50 REM  Ready for data transfer
60 POKE A,Data       Data 0..255 decimal
```

Alternatively the A-side can be set up as 8 digital inputs by writing 0 to the data-direction register, and setting bits 2, 3, 4 and 5 of the control register. The code for initialising the B-side as digital inputs is the same, except the addresses are incremented by two.

```
10 REM  Initialise B-side as digital Inputs
20 POKE A+3,0        Select DDR
30 POKE A+2,0        Select lines as inputs
40 POKE A+3,60       Select DR and Enable Buffer
50 REM  Ready for data transfer
60 DATA = PEEK (A+2)  Data 0..255 decimal
```

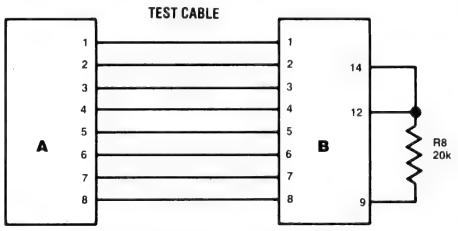
Programming analogue input/output

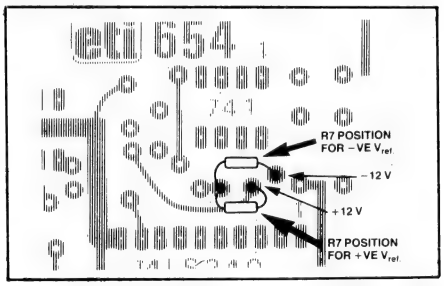
Analogue outputs are simple; just write to the digital-to-analogue converter.

```
10 POKE A+8,DATA      data 0..255 decimal
```

Analogue inputs are more complex because you first have to request a conversion, which also disables digital inputs, and then wait for the conversion to complete. Conversion is requested by setting bits 4 and 5 and clearing bit 3 of the B-side control register. When the conversion is complete, bit 7 of the control register is set to a one and an interrupt is generated, if interrupts are enabled. The data can be read from the B-side data register. This action also clears bit 7 of the control register. Conversion request must be removed and reapplied to request a second conversion. The program below loops on status, with interrupts disabled, until conversion is complete. Very little time can be gained by using interrupts because the analogue-to-digital conversion only takes 25 microseconds.

```
10 REM  Initialise B-side for digital input
20 REM  Request        A to 0 conversion
30 POKE A+3,52         Request conversion
40 X = PEEK (A+3)      Read status
50 IF X < 128 then 40  Test for complete
60 REM  Conversion complete
70 Input = PEEK (A+2)  Read data, clear status
80 POKE A+3,60         Recycle converter,
                       enable digital inputs
```





PARTS LIST — ETI-654

Resistors ..... all ¼W, 5% unless noted
R1, R5 ..... 1k
R2, R3 ..... 10k
R4 ..... 3k (see text)
R6 ..... 15R
R7 ..... 270R (see text)
R8 ..... 20k

Capacitors
C1 ..... 10u/25 V TANT.
C2, C3 ..... 4u7/25 V TANT.
C4, C5 ..... 10n greencap
C6 ..... 10p ceramic

Semiconductors
D1 ..... HP5082-2811 Schottky diode
LED1, 2 ..... HLMP6620 red sub-miniature resistor-LEDs
IC1 741
IC2 ..... AD7524
IC3 ..... 74LS00
IC4 6821
IC5, 7, 10 ..... 74LS241
IC6 ..... AD570
IC8, 9 ..... 74LS243
IC11 ..... 74LS240

Miscellaneous
ETI-654 pc board; 3 x 16-pin DIL sockets; 4 x 16-pin DIL plugs; 1 x 40-pin DIL socket; 4 x 20-pin DIL sockets; 1 x 18-pin DIL socket; 3 x 14-pin DIL sockets; 1 x 8-pin DIL socket; ribbon cable.

Price estimate
$45 — $50 (digital only)
$95 — $100 (complete)

Pascal

The card can be programmed from Pascal using the assembler function PEEK and procedure POKE. These two routines are compiled and linked to the Pascal-code file to form the executable program. The simple Pascal program reproduced in the panel over the page, which can be used to examine and modify memory, illustrates their use. From the viewpoint of the Pascal programmer PEEK and POKE behave like any other function or procedure. ▶

Applications

Possible applications of this card vary from controlling models to monitoring scientific experiments, as mentioned in the introduction. The following examples illustrate some of the ways the interface can be used.

A number of people use this interface card to control the Tasman Turtle Robot (see ETI project 645, April, May, June 1982). It was originally designed for use with the Terrapin turtle robot, which has the same interface signals. These robots require eight digital outputs to operate motors, lights, pen and horn, and four digital inputs from the touch sensors.

Other digital applications include: reading bar codes with a Hewlett-Packard bar code reader (HEDS 3000), driving a printer and reading a digital voltmeter. Heathkit sell a microcomputer-based weather station (kit ID 4001), which can be interfaced to a computer so that weather data can be collected and analysed (Warburton Franki handle Heathkit equipment in Australia).

The apparatus used in a physics experiment, designed to illustrate Newtons' second law, is shown in Figure 4. When the trolley is released, it accelerates along the table until it comes to rest against the buffer. The mass suspended from the pulley provides the accelerating force. A ten-turn potentiometer, connected to the pulley, produces an electrical voltage proportional to the distance the trolley is from the buffer. The signal is read with the analogue input and used to calculate trolley position, velocity and acceleration.

A very interesting application is the control of a slot car. Photodetectors (or in some cases, magnetic reed switches), connected to the digital input/output in a switch matrix configuration, can be used to detect which section of track the car is currently on. The analogue output can be used as a reference signal to an electronic speed controller (see ETI project 825, December 1981). The speed of a manually driven car is measured with the analogue input, recorded for each section of track and stored in a look-up table. When the car is under computer control the computer retrieves the speed for the section of track the car is on and uses it as a speed reference.

Further reading

1. Analogue Devices, *Data-Acquisition Components and Subsystems Catalogue,* 1980.
2. Apple II, *Hobby/prototyping board-product Specification.*
3. ETI project 645, Allan Branch, *Tasman Turtle,* April 1982 (and subsequent issues).
4. ETI project 825, Jonathan Scott, *Slot Car Controller,* December 1982.
5. McKerrow P.J., *Controlling a 'Turtle' with an 'Apple',* ACS National Microcomputer Conference, Canberra, July 1980, pages 18.1 — 18.11.
6. McKerrow P.J., *Micro-computers, Slot cars and Education,* IEEE Micro, February 1983.
7. Motorola, *Micro-processors Data Manual,* 1981.

ANALOGUE TEST PROGRAM

```
  5 PRINT
 10 PRINT "  APPLE ANALOG I/O TEST"
 15 PRINT
 17 PRINT "    DATA IS IN DECIMAL"
 20 REM  P.J.MCKERROW .....3.11.82
 80 REM  INITIALISE PIA
 90 REM  SET UP FOR SLOT 2
 91 REM  A=ADDRESS,V=MAX VOLTS OUT
 92 V=10
 95 A=-16224
100 POKE A+1,0
110 POKE A,255
120 POKE A+1,52
130 POKE A+3,0
140 POKE A+2,0
150 POKE A+3,60
155 PRINT
160 PRINT "   ANALOG  DATA"
170 PRINT "OUT     IN   VOLTS OUT *10"
180 O=1
240 GOSUB 2000
250 GOSUB 1000
260 O=2*O
270 IF O=256 THEN O=255
280 IF O<256 THEN 240
300 O1=1
310 O=255-O1
320 GOSUB 2000
330 GOSUB 1000
340 O1=2*O1
350 IF O1<255 THEN 310
400 END
1000 REM  WAIT LOOP
1010 T=0
1020 T=T+1
1030 IF T<500 THEN 1020
1040 RETURN
2000 REM  I/O ROUTINE
2010 POKE A+8,0
2020 POKE A+3,52
2030 X= PEEK (A+3)
2040 IF X<128 THEN 2030
2050 I= PEEK (A+2)
2060 POKE A+3,60
2070 V0=10*O*V/255
2080 PRINT O,I,V0
2090 RETURN
```

DIGITAL TEST PROGRAM

```
  5 PRINT
 10 PRINT "      APPLE I/O TEST"
 15 PRINT
 17 PRINT "    DATA IS IN DECIMAL"
 20 REM  P.J.MCKERROW.......3.11.82
 40 C=0
 50 W=-16224
 60 R=-16222
 65 PRINT
 66 PRINT "   FLASH LEDS "
 67 GOSUB 500
 70 REM  C=ERROR COUNT,I=TEST COUNT
 80 REM  W=WRITE ADDRESS,R=READ ADDRESS
 90 REM  X=DATA OUT,Y=DATA IN,T=TEMP
 91 PRINT
 92 PRINT "TEST  ERROR       DATA"
 96 PRINT "NO.   COUNT      OUT   IN"
100 FOR I=1 TO 100
105 GOSUB 300
110 FOR X=1 TO 255
120 POKE W,X
130 Y= PEEK (R)
140 IF Y=X THEN 150
142 C=C+1
144 PRINT I,C,X,Y
150 NEXT X
160 PRINT I,C
170 NEXT I
180 GOTO 400
300 REM  INITIALISE PIA
310 POKE W+1,0
320 POKE W,255
330 POKE W+1,52
340 POKE R+1,0
350 POKE R,0
360 POKE R+1,60
370 RETURN
400 END
500 REM  FLASH LEDS
505 FOR I=1 TO 10
510 POKE W+1,48
520 POKE R+1,48
530 GOSUB 600
535 PRINT I,""
540 POKE W+1,56
550 POKE R+1,56
560 GOSUB 600
580 NEXT I
585 C=0
590 RETURN
600 REM  WAIT LOOP
610 C=0
620 C=C+1
630 IF C<50 THEN 620
640 RETURN
```

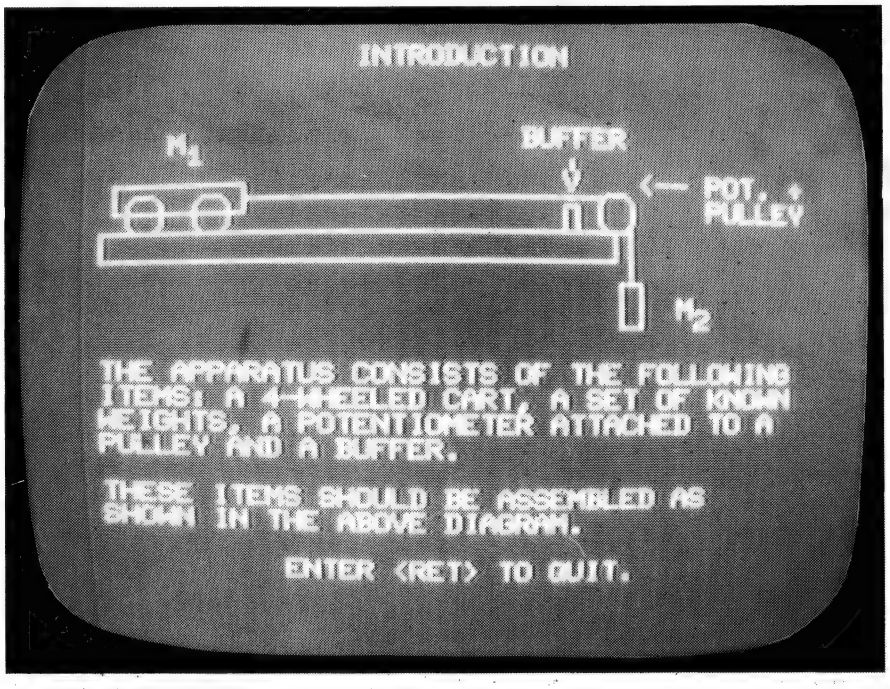
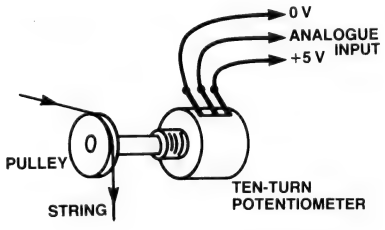


Figure 4. Apparatus for Newton's second law physics experiment. The potentiometer connections to the interface are shown below.



PASCAL PROGRAM EXAMPLE

```
PROGRAM EXAM;
(*USED TO EXAMINE AND MODIFY MEMORY*)
(*PHILLIP MCKERROW    29.10.82*)
VAR TERM,DATA,DAT1,ADDR:INTEGER;
    REQUEST:CHAR;
PROCEDURE POKE(DATA,ADDR:INTEGER);
EXTERNAL;
FUNCTION PEEK(ADDR:INTEGER):INTEGER;
EXTERNAL;

BEGIN
WRITELN ('EXAMINE AND MODIFY MEMORY');
WRITELN (' ALL VALUES ARE DECIMAL');
WRITELN ('  DATA 0-255');
WRITELN ('  ADDRESS -32768 TO 32767');
WRITELN;
TERM :=0;
WHILE TERM=0 DO
 BEGIN
 WRITE (' E:XAMINE,M:ODIFY,Q:UIT -  ');
 READLN (REQUEST);
 CASE REQUEST OF
      'E' : BEGIN
            WRITE ('ADDRESS PLEASE ');
            READLN (ADDR);
            DATA := PEEK(ADDR);
            WRITELN (' ',DATA);
            END;
      'M' : BEGIN
            WRITE ('DATA,ADDRESS PLEASE ');
            READLN (DATA,ADDR);
            POKE (DATA,ADDR);
            DAT1 :=PEEK(ADDR);
            IF DAT1<>DATA THEN
             WRITELN('ERROR ',DATA,DAT1);
            END;
      'Q' : TERM :=1;
 END;
END;
 WRITELN ('BYE BYE');
END.
```

ASSEMBLER PROGRAM EXAMPLE

```
;THE UNIVERSITY OF WOLLONGONG
;PHILLIP MCKERROW   3.11.82
;
;  MACRO POP ADDRESS
;POPS 16 BIT ARG FROM STACK TO ASSRESS
;
        .MACRO POP
        PLA             ;PULL LS BYTE
        STA %1
        PLA             ;PULL MS BYTE
        STA %1+1
        .ENDM
;
;  MACRO PUSH ADDRESS
;PUSHES 16 BIT ARG TO STACK
;
        .MACRO PUSH
        LDA %1+1
        PHA             ;PUT MS BYTE
        LDA %1
        PHA             ;PUT LS BYTE
        .ENDM
;
        .FUNC PEEK,1
;   FUNCTION PEEK(ADDRESS:INTEGER):INTEGER;
;RETURNS CONTENTS OF SPECIFIED ADDRESS
;8 BITS OF DATA RETURNED IN LS BYTE
;MS BYTE SET TO ZERO
;
RETURN .EQU 0       ;STORAGE FOR RETURN ADDRESS
ADDR    .EQU 2      ;ADDRESS OF DATA
        POP RETURN          ;GET RETURN ADDRESS
        PLA                 ;STACK BIAS
        PLA
        PLA
        PLA
        POP ADDR            ;GET ADDRESS
        LDA #0
        PHA                 ;SET MS BYTE TO 0
        LDY #0
        LDA @ADDR,Y         ;GET DATA
        PHA                 ;RETURN DATA
        PUSH RETURN
        RTS                 ;GO BACK
;
        .PROC POKE,2
; PROCEDURE POKE(DATA,ADDR:INTEGER)
;PROCEDURE TO WRITE TO ADDRESS
;
RETURN .EQU 0
ADDR    .EQU 2
        POP RETURN      ;SAVE RETURN ADDRESS
        POP ADDR        ;MEMORY LOCATION
        LDX #0
        PLA             ;GET OUTPUT
        STA @ADDR,X     ;POKE
        PLA             ;CLEAN UP STACK
        PUSH RETURN
        RTS             ;GO BACK
        .END
```

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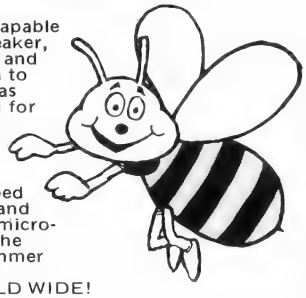

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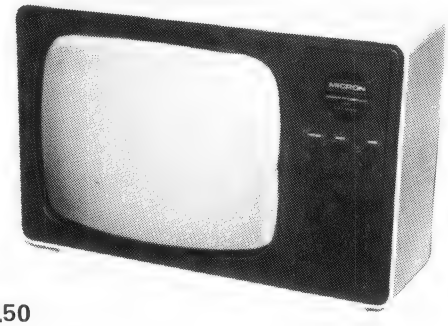

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ROM		
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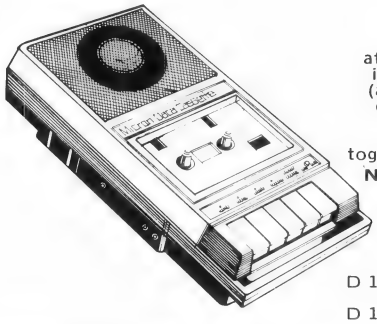

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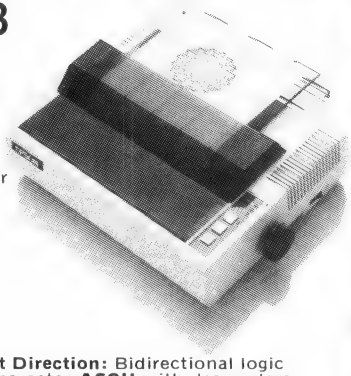
EPSON MX80/3 DOT MATRIX PRINTER



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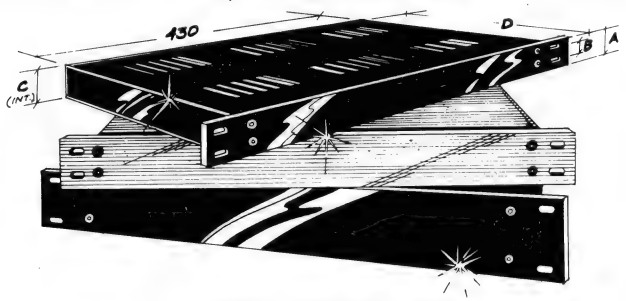

INTRODUCTORY PRICES

Cat No.	Finish	A	B	C	PRICE	5 or More
H 0401	Natural	44	34	38	**$42.50**	**$39.95**
H 0402	Natural	88	57	82	**49.95**	**47.50**
H 0403	Natural	132	89	126	**55.00**	**49.95**
H 0411	Black	44	34	38	**42.50**	**39.95**
H 0412	Black	88	57	82	**49.95**	**47.50**
H 0413	Black	132	89	126	**55.00**	**49.95**

Beware of other rack boxes that do not conform to international rack sizing.

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FEATURING: Digital frequency Display, SSB CW, FM AM reception, B.F.O., Double Conversion, Double Super-het, crystal controlled (VHF) Local Oscillator, 4 inbuilt antennas and good looks, you will spend hours just learning how to drive it!

See Review in Electronics Australia August 1982

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SPECIFICATIONS:

Semi-conductors: 1-LSI, 4 - IC's, 7 - FET, 34 - Transistors, 42 - Diodes

Frequency range:

LW	145-360	KHz	SW3	9-22	MHz	VHF3	88-108	MHz
MW	525-1600	KHz	SW4	22-30	MHz	VHF4	108-136	MHz
SW1	1.6-3.8	MHz	VHF1	30-50	MHz	VHF5	144-176	MHz
SW2	3.8-9	MHz	VHF2	68-86	MHz	UHF	430-470	MHz

Power supply: AC 240V 50Hz. DC 12V (8 x "D" cells). Ext. DC 12V Car/Boat.
Speaker: 12.5cm Permanent Dynamic Speaker (3.2 ohm)
Antenna: Ferrite Bar Antenna for LW, MW and SW1
3 x Telescopic Antenna for SW, VHF and UHF
Controls: Power ON-OFF switch – Digital display ON-OFF switch – Tape-Radio switch, Wide-Narrow band selector switch, AM band selector (LW/MW/SW1/SW2/SW3/SW4), VHF band selector (VHF1/VHF2/VHF3/VHF4/VHF5/UHF), Ant. Selector (Telescopic ANT./EXT. ANT.), Tuning control (direct gear drive), volume control, Bass control, Treble control, Squelch control, BFO pitch control, RF gain control, Antenna adjustor control, Mode switch (USB-NOR-LSB/CW)
Terminals: Ext. Speaker/Headphone Jack, Tape IN-OUT jack, VHF/UHF ANT. connector (coaxial), SW EXT. ANT. terminal (Screw), Ext. battery jack
Meter: Tuning Meter
Digital Frequency Counter Section:
Display: LW/MW/SW-1 KHz SW2-4/VHF1-5 MHz
Control: SW Calibrator **Dimensions:** 452mm (W) x 288mm (H) x 130mm (D)

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Please note that resellers may not have all the items advertised in stock, and as resellers have to bear the cost of freight, prices may be slightly higher than advertised. ALTRONICS reseller prices should however represent a considerable saving over our competitors' prices.

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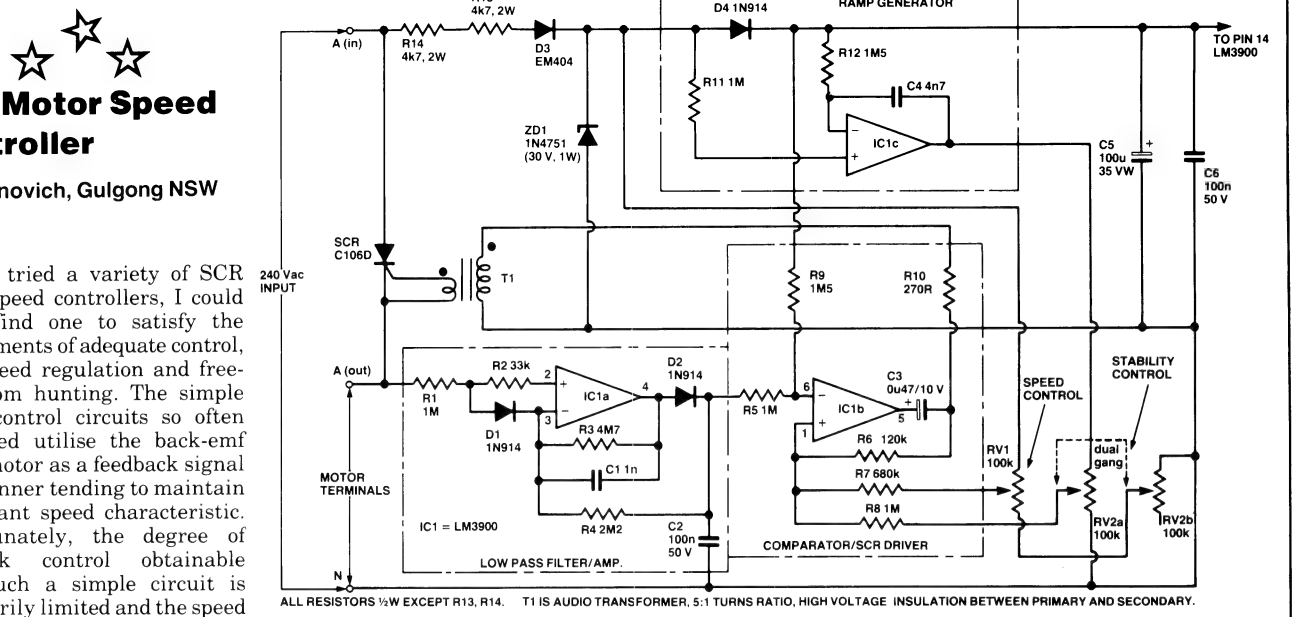

SCR Motor Speed Controller

H. Nacinovich, Gulgong NSW

Having tried a variety of SCR motor speed controllers, I could never find one to satisfy the requirements of adequate control, good speed regulation and freedom from hunting. The simple phase control circuits so often published utilise the back-emf of the motor as a feedback signal in a manner tending to maintain a constant speed characteristic. Unfortunately, the degree of feedback control obtainable with such a simple circuit is necessarily limited and the speed regulation, as a result, is relatively poor.

The overall performance is a compromise between a combination of factors which determine, on the one hand, the degree of feedback control and on the other, stability (i.e: freedom from hunting, hysteresis etc). The two are inversely related. If you want maximum stability, you sacrifice feedback control, and vice versa.

Phase control over a full 0 to 180 degrees is impossible, in fact, it's considerably less. Component values are critical and dissipation in the control pot is fairly high.

The circuit I devised, after considerable investigation and many trials performs far better than any I have previously tried. It gives halfwave phase control virtually from 0° to 180° of the mains cycle, it has independently adjustable speed and stability controls, operation is independent of SCR characteristics and it provides stable operation even at low motor speeds with good speed/torque characteristics.

This circuit controls the speed of 240 V universal (ac/dc) motors. On no account must the circuit be used for appliances which are suitable only for ac operation, such as induction motors.

An SCR connected between input and output terminals of the circuit conducts on positive half-cycles of the ac supply. Triggering of the SCR is phase controlled. The triggering phase angle is variable over nearly a full 0° to 180° of each positive half-cycle. The back-emf generated by the motor during the intervals between conduction cycles of the SCR is used as a feedback signal to compensate for varying load conditions imposed upon the motor.

There are two variable control functions, one of which provides the 'speed' setting and the other of which is a 'stability' (or 'gain') control. The latter determines the feedback characteristics of the circuit and can be adjusted to obtain optimum performance from a motor with which the circuit is to be used.

This is an unusual and extremely useful feature as it can be used to programme the speed/torque characteristics of a given motor over a wide operating range and to adjust for an optimum balance between feedback control and motor stability under given operating conditions.

This is especially useful at low speed settings at which the back-emf of any motor is low and it is difficult otherwise to achieve both good torque characteristics and stable motor running.

The circuit uses ¾ of an LM3900 quad op-amp IC to control the phase triggering of the SCR. The voltage across the motor terminals is converted into a current signal which is applied to the non-inverting input of IC1a.

During the intervals between conducting cycles of the SCR this signal, which is proportional to the back-emf (and hence speed) of the motor, is amplified by IC1a.

The amplified signal is applied to capacitor C2 via diode D2. The capacitor C2 holds its charge sufficiently long each cycle to present a relatively clean dc signal to comparator IC1b. That is, a signal which is relatively free of spikes and other spurious noise components which could cause erratic phase triggering of the SCR. Capacitor C1 helps by filtering out most of these components before the signal is applied to C2.

Diode D1 ensures that the output of IC1a goes low when the SCR conducts as otherwise C2 would be charged up to a voltage proportional to the applied mains voltage rather than to the back-emf of the motor. In this regard, the ratio of resistors R1 and R2 is chosen so that diode D1 conducts when the input voltage exceeds the maximum (typical) back-emf of the motor (about 15 V).

An integrator, IC1c, provides a ramp signal which is synchronised to the phase of the supply. The amplitude of the ramp signal is varied by potentiometer RV2a and applied to an input of comparator IC1b. Potentiometer RV2a forms the 'stability' control.

An adjustable bias signal is obtained from potentiometer RV1 and applied to the same input as the ramp signal. Potentiometer RV1 forms the 'speed' control.

The feedback performance of the circuit is determined by the amplitude of the ramp signal applied to the comparator relative to the amplitude of the signal from IC1a. Adjustment of RV2, since it varies the signal applied to IC1b also affects the speed. To minimise this effect, a compensating variable resistor, potentiometer RV2b is connected in series with RV1 and ganged with RV2a.

The SCR is triggered by a pulse output produced by IC2, via a transformer. In this case an ordinary transistor output transformer taken out of the 'junk-box' was used. This transformer happened to have a turns ratio of about 5:1 and works well but other ratios may also be satisfactory.

Before it was used however, the pulse response of the transformer was checked with a signal generator and CRO. Most importantly, the insulation between primary and secondary windings was checked to make sure that it would withstand the peak mains voltage.

The power requirements for the IC are modest and thus a simple voltage dropping resistor arrangement was used in preference to a more expensive step-down transformer. The zener diode ensures a stable operating voltage which is virtually immune to mains voltage variations. The diode D3 is optional but has the advantage that it halves the power dissipated in resistors R12 and R13. Apart from these resistors, all resistors may be standard ½ watt, 5% types.

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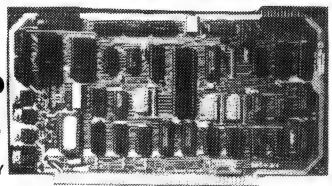

FEATURES:

The QT Computer SBC 2/4 Processor Board may be used as a stand-alone computer or as the host CPU of a large system. It works reliably with dynamic RAM boards and more importantly with soft sectored disk controllers, and hence standard versions of CP/M. This gives access to the largest software base for microcomputers. 2 or 4 MHz switch selectable. ● 1K RAM (can be located at any 1K boundary) ●one each serial and parallel I/O ports ●power on jump to on board EPROM (2708 or 2716) addressable on any 1K or 2K boundary ●full 64K use of RAM in shadow mode ●2 programmable timers avail. for use by programs ●DMA capability allows WRT signal generation on CPU board or elsewhere in system under DMA or front panel control ●programmable baud rate 110-9600

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12 slot A&T	$138.00	$145.80
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18 slot A&T	$178.00	$190.20

QT CARD CAGES

QT card cages are strong, cadmium-plated steel frames, punched ready-to-accept card-guides and motherboard. Perfectly suited for industrial control applications with the addition of CPU and memory card with the Silence+ Motherboard.

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incl motherboard, etc	$117.00	$140.40
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DUAL 5¼" DRIVES
432mmLx178mmHx508mmD

DUAL 8" DRIVES
432mmLx244mmHx532mmD

- Power and Reset switches on front
- Fully professional

The QT Mainframes are, we believe, the most versatile models on the market. They will accomodate 6, 8 or 12 slot card cages using the Silence+ Motherboards. Any 5¼ inch, 8 inch standard or slimline disk drives can be fitted. Adequate space is available for a fan and power supply (these are included in assembled and tested versions). Just add a CPU, memoryboard, disk controller and terminal and you have an inexpensive, high quality computer system. The finish is beige with brown cover.

Prices are for 5¼" or 8" sizes.

	No Tax	Incl Tax
Bare cabinet	$198.00	$237.60
incl 6 slot M/board (A&T)	$552.00	$662.40
incl 8 slot M/board (A&T)	$581.00	$697.20
incl 12 slot M/board (A&T)	$612.00	$734.40

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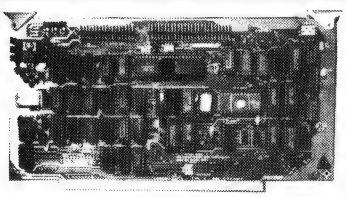
5¼" Dual Mini Cabinet	$ 39.00	$ 46.80
incl. power supply (A&T)	$159.00	$190.80
8" Single Cabinet	$ 89.00	$106.80
8" Single standard drive or dual slim-line cabinet incl. power supply (Assembled and Tested)	$295.00	$354.00

DISK DRIVE CONTROLLER



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Specially designed to rectify loss in detail derived from VCR tapes and picture impairments. Ideal for off-air recording, dubbing from VCR to VCR etc. Outputs for up to 3 separate VCR's for multi-machine recording.

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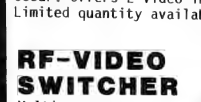
IMAGE STABILIZER



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Stability control immediately stabilises picture of pre-recorded tapes, removing the copyguard signal. Also ensures no vertical roll or blackout will occur. Offers 2 video inputs (A or B), output for 1 VCR only. Limited quantity available at these fantastic prices.

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Multi-purpose use, very low loss, RF inputs for aerial, home computer, video games, VCR, etc.

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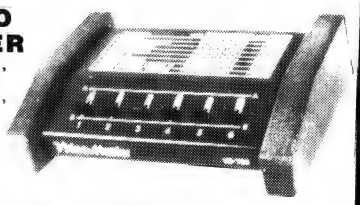
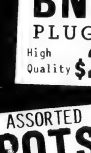


Output: 75 ohms to TV set. beautifully styled, timber ends.

LEDs



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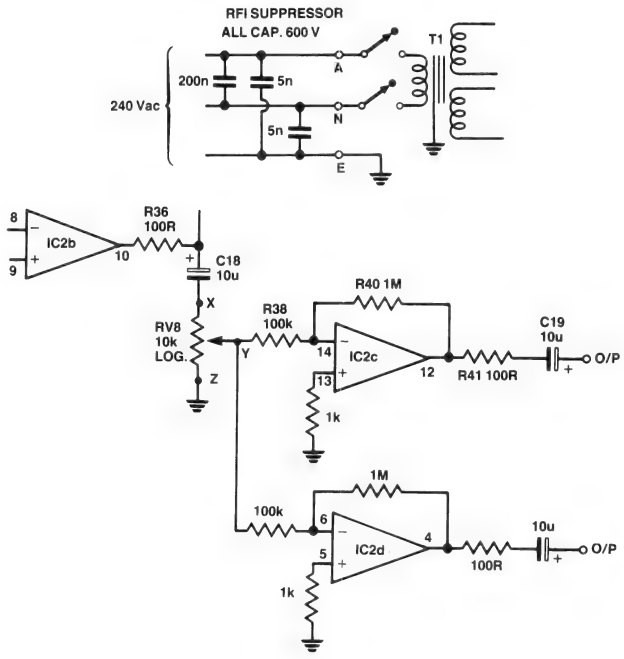
Polythene ties and rubber feet

Phillip Denniss of Chippendale NSW sent in two 'handy hints' which you may find useful.

The polythene ties which come with some garbage bags can be quite useful for tying up excess power cable or signal leads in a hi-fi system, tying up pieces of hook-up wire, etc. Then you may have a problem coping with a full bag of garbage, but as ETI is not concerned with garbage I shall not elaborate along that line.

In small projects where you need some cheap rubber feet, try using foam sealing tape which is used for doors and windows. I suggest Engels No. 5D as it is made from PVC and is thicker and denser than most of the other brands. If it is cut into squares 12 mm wide you can get over 200 feet per roll, making the cost about 2¢ per foot (or 8¢ for one box with four feet). Being adhesive backed it is very simple to use and is available from hardware stores.

Output splitter to feed stereo input

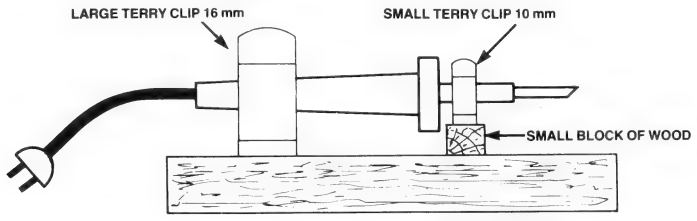


Having built up the ETI-467 Four Input Mixer/Preamp, **Alec Phillips of Myrtleford Vic.** discovered two interesting things.

I constructed a chipboard cabinet with a metal face panel and found it necessary to earth the front panel and also shield and earth the whole of the interior of the cabinet with tin foil. This was to stop hum from being picked up by the tone circuit. I also fitted the RFI filter as shown to remove additional mains hash.

Wanting to use my mixer with a stereo amplifier I experimented with various splitting arrangements for the mixer O/P with varied but only moderate success. Then on close scrutiny of the circuit, it was discovered that IC2d wasn't being used. So with the addition of four resistors, one capacitor and paralleling off Y I had the perfect splitter to feed my left and right AUX I/P and not affect any other stereo I/P signals.

The end results were very noise-free and pleasing.



Soldering iron holder

A soldering iron holder, cheap and easy to make, has been designed by **George Michail of Unley SA.**

All you need are two terry clips and two blocks of wood and it can be built onto your work bench.

'IDEA OF THE MONTH' CONTEST

NEW PRIZE! WORTH $90!

COUPON

Cut out and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.**

"I agree to the above terms and grant Electronics Today International all rights to publish my idea in ETI Magazine or other publications produced by them. I declare that the attached idea is my own original material, that it has not previously been published and that its publication does not violate any other copyright*".

* Breach of copyright is now a criminal offence.

Title of idea .....

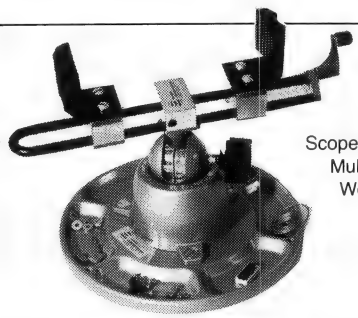
Signature .....

Name .....

Date .....

Address .....

..... **Postcode** .....



Scope Panavise Multi-purpose Work Centre.

Scope Laboratories, who manufacture and distribute soldering irons and accessory tools, have offered to sponsor a contest with a prize to be given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI. Each month we will be giving away a Scope Panavise Multi-purpose Work Centre, Model 376/300/312, comprising a self-centering head (376), standard base (300) and tray base mount (312), all worth about $90! Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each winner will be paid $10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Scope Laboratories, Murray Publishing, Offset Alpine, Australian Consolidated Press and/or associated companies.

Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of the last day of the month.

The winning entry will be judged by the Editor of ETI, whose decision will be final. No correspondence can be entered into regarding the decision.

Winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI.

Contestants must enter their names and address where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries.

Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

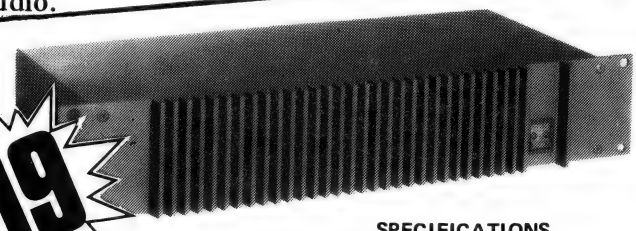
SO PURE, IT'S WICKED

The ETI 5000 System. Pristine. Pure. Cocaine for the ears.
And to think that they are Australian made and designed. They can stand comparison with any kit or ready-built available – anywhere. In fact we still think that they are the world's best amplifiers. We should be justifiably proud of this achievement in Audio.

"BLACK MONOLITH"

REF: ETI JAN/MARCH 1981

Cat. KE4200



$319

SPECIFICATIONS

POWER OUTPUT	Around 100W RMS into 8 ohms
FREQUENCY RESPONSE	8Hz to 20kHz, +0 – 0,4dB 2,8Hz to 65kHz, +0 – 3dB Note: these figures are determined soley by passive filters
INPUT SENSITIVITY	1V RMS for 100W output
HUM	– 100dB below full output (flat)
NOISE	–116dB below full output (flat,20kHz bandwidth)
2nd HARMONIC DISTORTION	<0,001% at 1kHz (0,0007% on prototypes) at 100W output using a ±56V supply rated at 4A continuous
3rd HARMONIC DISTORTION	<0,003% at 10kHz and 100W
TOTAL HARMONIC DISTORTION	<0,0003% for all frequencies less than 10kHz and all powers below clipping
INTERMODULATION DISTORTION	Determined by 2nd harmonic distortion (see above)
STABILITY	<0,003% at 100W (50Hz and 7kHz mixed 4;1)
	Unconditional

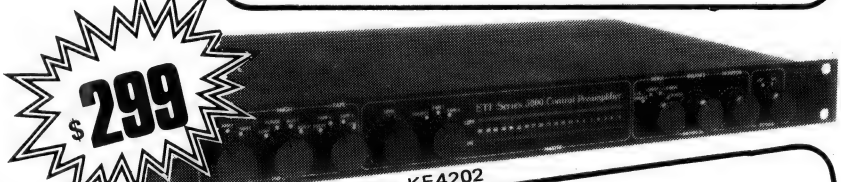
We regret to advise that among other things, metal-work and sales tax increases have forced us to increase our prices slightly. Whilst we could have kept our costs down by using inferior components, we refused to take this course of action.

The ultimate Hi-Fi- power amplifier. We call our model the "Black Monolith" because we feel that the name symbolises the intelligence that went into the design.
The Jaycar "Black Monolith" is without doubt the best kit of the project available. If you have doubts ring our Managing Director, Gary Johnston and he will tell you! (Be prepared for a long conversation).
Several kit suppliers now have 'versions' of the original 5000 P.A. which claim to be similar to ours. This is simply not the case.
Space does not allow us to show EVERY refinement that has been made to the 5000 but notable ones are:
EXCLUSIVE FEATURES:
- Rear panel mains fuseholder
- 1% METAL FILM resistors used
- Flux-shorting strap on power transformers
- Original chassis bar design
- Beryllium Oxide (Space Age Ceramic) TO-3 washers. (NOT flimsy Mica)
- Jig drilled and extruded heavy gauge, anodised heatsink bracket
- SUPERFINISH front panel. STILL THE BEST now with blind tapped holes
- New heavy duty heatsinks for the driver transistors. 100% extra heatsink area and black anodised for greater efficiency (NOT in original design)
- Ventilation holes in metalwork at critical points (NOT in original design)
- Extra 3 pin DIN socket on rear panel (total 2) to power new 5000 components

IF YOU THINK THAT YOU CAN SAVE MONEY ON THESE KITS ASK YOUR SUPPLIER IF HE WILL GIVE YOU ALL OF THESE FEATURES AT THE PRICE. MAKE SURE THAT YOU GET IT IN WRITING!! (Write for new glossy leaflet (SAE))

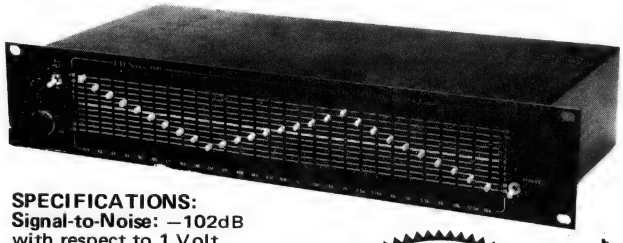
5000 SERIES GRAPHIC EQUALISERS

$299



Cat. KE4202

Latest addition to the thoroughbred 5000 Series stable! David Tillbrook has once again produced a 'No Compromise' design. This new component, a 1/3 octave equaliser, gives you ABSOLUTE CONTROL over the acoustics of your particular listening enviroment. You get 3 SEPARATE CONTROLS for every octave of audio bandwidth to virtually eliminate the subtle nuances that are particular to your listening area.
1/3 octave equalisers have been used by professional engineers in Recording Studios and Live Concerts for over a decade now. It is no accident that the advent of the 1/3 octave equaliser and studio quality live sound have gone hand-in-hand. BUT THERE'S A CATCH. One of these equalisers is not enough. You will have to buy 2 (for stereo). Quite a lot of money – but worth it if you want the best. The Jaycar kit includes a fully pre-punched plated chassis, pre-punched heavy gauge front panel with silkscreened front panel to match the other 5000 components. It is absolutely original. You can purchase the kits one at a time for $199 each or, for two, $389 – a $10 saving. If you are one of the hundreds of happy 5000 users we are convinced that you will be just delighted with this unit.



SPECIFICATIONS:
Signal-to-Noise: –102dB with respect to 1 Volt
Frequency Response: 12Hz – 105kHz to –1dB
Boost/Cut: 14dB (28dB total)
Distortion: 100Hz-0.007%
1kHz-0.007%
10kHz-0.008%
(essentially irrepective of cut or boost)
Current consumption (DC) Approx 100mA @ ±15V (Requires 30V AC CT)
Output short-circuit proof.

$199

BUY 2 AND SAVE $10 – ONLY $389

AUSTRALIAN (NOT HONG KONG) MADE – SPECIAL BUILT RACK CABINET – QUALITY!!!

ALL IC SOCKETS PROVIDED

Cat. KE4204

"BLUEPRINT"

"One Swallow does not make a spring" – Neither does a few gold RCA sockets!
Several of our competitors are imitating our "Blueprint" preamp by adding a few bits and pieces, notably gold plated RCA sockets to their standard kits. Unfortunately they have missed the point. We supply gold plated sockets in our "Blueprint" preamp but only where it makes sense to do this, i.e. on the inputs – NOT the outputs. 16 gold sockets are provided by us. This, however, does not make a "Blueprint". THIS DOES:
- Low capacitance screened cable - 12 metres of it. NOT Taiwanese cable as supplied in other kits. Our cable costs us NEARLY 5 TIMES MORE than the Taiwanese stuff.
- Original ETI designed front panel. Not an "ADAPTION". Our front panel is by far the nicest.
- Factory pre-tinned PCB's to reduce chances of dry or noisy solder joints.
- Quality LEDs, polished finish, multicoloured display.
- IC sockets on line amp board.
- Special rear panel.
- Special low noise selection LM394H NOT CH device in M.C. preamp.
- Thermalloy (U.S. made) heatsink on 7805 regulator.
- English Lorlin selector switches.
- Apart from the 16 gold RCA's we throw in a pair of gold plated line RCA plugs – worth $5.
- Special Nylon rear panel grommets.

So don't "Swallow" the facts before they are properly digested!!
You can't make a silk purse out of a sow's ear. Send SAE for full specs.

FUNCTIONS
- MOVING COIL INPUT
- MOVING MAGNET (DYNAMIC CART)
- INPUTS (2 OFF)
- TUNER INPUT
- AUX INPUTS (2 OFF)
- TAPE INPUTS (2 OFF)
- INPUT LEVEL CONTROL
- TAPE OUTPUTS (2 OFF)
- 400Hz CALIBRATION OSCILLATOR
- LED AVERAGE (VU) & PEAK
- LEVEL METERS –48dB TO +9dB
- MODE SWITCH, STEREO BALANCE CONTROL LINE OUT, MONITOR OUT, MONITOR VOLUME CONTROL

FEATURES
- EXTREMELY CLOSE TRACKING TO RIAA PHONO EQ.
- GOLD PLATED CONNECTORS ON ALL INPUTS
- ENGLISH 'LORLIN' LOW NOISE SELECTOR SWITCHES
- LOW NOISE 1% 50ppm METAL FILM RESISTORS USED
- TINNED FIBREGLASS PCB's
- LOW CAPACITANCE SCREENED CABLE USED THROUGHOUT
- QUALITY I.C. SOCKETS
- SPECIAL REAR PANEL
- MULTICOLOURED RECTANGULAR LEDs USED

Jaycar NUMBER 1 FOR KITS

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"NEVILLES CORNER"
Cnr. CARLINGFORD & PENNANT HILLS ROAD, CARLINGFORD
PHONE: 872 4444
MAIL ORDERS TO: BOX K-39 HAYMARKET, SYDNEY 2000

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$25 – $49.99 ($4.50) $50 – $99.99 ($6.50)
$100 up ($8.00)

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Mon – Fri 8.30 to 5.30pm
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Mail Order By BANKCARD Via Your Phone

SHOPAROUND

This page is to assist readers in the continual search for components, kits, printed circuit boards and other parts for ETI projects and circuits. If you are looking for a particular item or project and it is not mentioned here, check with our advertisers.

ETI-268 Float charger

Be kind to your NiCads and give them proper charging treatment. This project will look after them, never overcharging, ensuring they have a long life of many charge-discharge cycles. At time of going to press, the following firms indicated they would be stocking kits: **Altronics** (Perth), **Dick Smith Electronics** (stores all over), **Jaycar** (Sydney), **Rod Irving Electronics** (Melbourne). Also try **All Electronic Components** in Melbourne.

If you're making your own pc board and taking the components from your stockpile, you probably won't have the LM336 on hand. We obtained ours from **Radio Despatch Service** in Broadway, Sydney. Any supplier stocking National Semiconductor devices and worth his salt will either have it in stock or order it in for you. It's an under-$2 item.

ETI-654 interface

Despite its apparent complexity, this project is relatively simple to construct and get going. The pc board is a double-sided, plated-through hole type so you won't be able to make your own — unless you have the right facilities! If you don't need the analogue facilities (or would like to leave that till a later date), then you can leave out IC1 (741), IC2 (AD7524) and IC6 (AD570). This will save you some money as the A-D and D-A converters are relatively expensive devices.

Kits in one form or another will be available from **Rod Irving Electronics** in Melbourne and **Jaycar** in Sydney.

The AD7524 DAC and AD570 ADC are distributed by **Parameters Pty Ltd,** Sydney (02) 439-3288 and Melbourne (03)580-7444.

ETI-335 wiper controller

Despite the relative complexity of the circuit of this project (relative to previous wiper controllers, that is) it's quite simple to put together. All the components are widely available 'off the shelf', so constructors should have no difficulty getting it together.

Kits will be available from **Altronics** in Perth, **Rod Irving** and **All Electronic Components** in Melbourne and **Dick Smith** stores in all states.

Printed circuit board and panel suppliers

Almost every pc board ever published by ETI may be obtained from the following suppliers:

All Electronic Components
118 Lonsdale St
Melbourne Vic. 3000

RCS Radio
651 Forest Rd
Bexley NSW 2207

Panels, meter scales and dial faces for almost every ETI project published may also be obtained from the above two firms.

For pc boards produced over the past three to five years, the following suppliers generally keep stocks on hand:

Electronic Agencies
115-117 Parramatta Rd
Concord NSW 2137
and
117 York St
Sydney NSW 2000

Radio Despatch Service
869 George St
Sydney NSW 2000

Rod Irving Electronics
425 High St
Northcote Vic. 3070

James Photronics
522 Grange Rd
Fulham Gardens SA 5024

Jamal Products
P.O. Box 168
Victoria Park WA 6100

Sunbury Printed Circuits
Lot 14, Factory 3,
McDougall Rd
Sunbury Vic. 3429

Mini Tech
P.O. Box 9194
Auckland N.Z.

ETI BOOK SALES

Save time and trouble with mail order. Just fill out the coupon on page 58

electronics textbooks

ELECTRONICS — IT'S EASY VOL. 1 **$5.95**
Meters, resistance, capacitance and inductance, emitter followers, op amps, power supplies and electronic filters.

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Same content in a hard-cover form.

ELECTRONICS — IT'S EASY VOL. 2 **$5.95**
Digital sub-systems counters and shift registers, A-D and D-A conversion, digital instruments and test equipment, computers, transmission links and oscilloscopes.

ELECTRONICS — IT'S EASY VOL. 2 **$12.95**
Same content in a hard-cover form.

ELEMENTS OF ELECTRONICS
This series is an introduction to modern electronics. All the maths is taught as the reader progresses. The course concentrates on the understanding of concepts central to electronics, rather than digressing over the whole field. The author anticipates where difficulties lie and guides the reader through them.

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All fundamental theory necessary to full understanding of simple electronic circuits and components.

BOOK 2
BP63 **$7.52**
Alternating current theory.

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BP64 **$7.52**
Semiconductors technology leading to transistors and ICs.

BOOK 4
BP77 **$9.76**
Microprocessing systems and circuits.

BOOK 5
BP89 **$9.76**
Communications.

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST
228B **$4.32**
This book supplies the electronics hobbyist with the background knowledge which will exactly suit their specific requirements. Minimum maths.

BEGINNER'S GUIDE TO DIGITAL ELECTRONICS
BP61 **$3.36**
Covers all essential areas including number systems codes, constructional and sequential logic, analogue/digital/analogue conversion.

A MICROPROCESSOR PRIMER
BP72 **$5.92**
Learning about microprocessors is easy with this book, written in a style that is easy to follow. The shortcomings of this basic machine are discussed and the reader is shown how these are overcome by changes to the instruction set. Relative addressing, index registers follow as logical progressions.

reference and data handbooks

AUDIO CYCLOPEDIA
20675P **$66.00**
A complete, in-depth look at the art of audio — from the basic principles of sound to solid-state and integrated circuits. Over 3000 entries and hundreds of illustrations and circuit diagrams cover acoustics, amplifiers, recording, reproduction, test equipment, audio measurements, and much more.

REFERENCE DATA FOR RADIO ENGINEERS
21218P **$21.95**
The largest and most comprehensive collection of equations, graphs, tables, and other reference data needed in general radio engineering and design. Contains hundreds of charts, monographs, diagrams, curves, tables and illustrations.

TUBE SUBSTITUTION HANDBOOK
21746P **$8.75**
Complete, accurate, up-to-date guide to direct substitutes for receiving and picture tubes. Contains over 6000 receiving tube substitutes, over 4000 monochrome and colour picture tube substitutes, and 600 communications substitutes. Also includes pinouts for quick operational checks.

CONTEMPORARY MATHEMATICS FOR ELECTRONICS
70274P **$29.75**
This book is split into three sections. Direct current maths introduces the student to the calculator, fractions and dimensional analysis. Alternating current maths covers phasors, quadratics and RMS in both sine and digital waveforms. Active device maths introduces number systems and boolean.

AUSTRALIAN MICROCOMPUTER HANDBOOK
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Normally $25.00. A detailed buyer's guide to microcomputer systems and application packages in commercial, industrial, scientific, educational and home/hobby areas.

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HANDBOOK OF ICS EQUIVALENTS AND SUBSTITUTES
202B **$5.76**
Contains full interchangeability data on more than 9500 ICs with possible alternatives and equivalents shown. Covers many types of digital and linear ICs.

HANDBOOK OF RADIO, TV, INDUSTRIAL & TRANSMITTING TUBE & VALVE EQUIVALENTS
BP2 **$2.25**
Equivalents book for amateurs and servicemen. More than 18 000 old and new valves from UK, USA, Europe, Japan et al. CV (military) listings with commercial equivalents included.

RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART
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This large wall chart covers all colour codes in use throughout the world. For all radio and electronic components made in UK, USA, Europe and Japan.

FIRST BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
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This guide covers many thousands of transistors showing possible alternatives and equivalents. Covers transistors made in UK, Japan, USA, Germany, France, Europe, Hong Kong and includes types produced by more than 120 different manufacturers.

SECOND BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
BP14 **$5.92**
Interchangeability data covers semiconductors manufactured all over the world. Immediate equivalents are shown and possible substitutes are included.

GIANT CHART — RADIO, ELECTRONICS, SEMI-CONDUCTORS & LOGIC SYMBOLS
BP27 **$1.92**
Identify those symbols at a glance. A must for beginners and advanced enthusiasts alike. Professionals can always hide it in their desks!

RESISTOR SELECTION HANDBOOK
BP28 **$2.24**
Shows how to combine two preferred values of resistor to obtain virtually any required value of resistance. Includes information about fixed resistors, standard ranges, colour codes and markings, power ratings and resistor calculations.

ELECTRONIC CALCULATOR USERS' HANDBOOK
BP33 **$5.12**
Presents formulae, data, methods of calculation, conversion factors, etc, for use with the simplest or most sophisticated calculators. Includes the way to calculate using only a simple four-function calculator: trigonometric functions, hyperbolic functions, logarithms, square roots and powers.

DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS
BP40 **$12.32**
Revised edition showing Japanese, American and European equivalents and pin connections of a popular user-orientated selection of digital ICs (available mid 1983).

LINEAR EQUIVALENTS AND PIN CONNECTIONS
BP41 **$9.12**
Shows equivalents and pin connections of a selection of popular linear ICs, with details of families, functions, country of origin and manufacture. Includes devices from Analog Devices, Advance Micro Devices, Fairchild, Harris, ITT, Motorola, Philips, RCA, Raytheon, Signetics, Sescocrem, SGS-ATES, Siemens, AEG-Telefunken, Teledyne, Texas Instruments.

PRACTICAL ELECTRONIC CALCULATIONS & FORMULAE
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For the practical person's workbench. Bridges gap between technical theory and cut-and-dried methods which work but leave the experimenter unfulfilled. There's a strong practical bias. Tedious and higher maths avoided where possible.

INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE
BP85 **$9.76**
Companion to BP1 and BP14 equivalents books, but contains a huge amount of information on modern transistors produced by over 100 manufacturers. Wherever possible, equivalents are subdivided into European, American and Japanese types. Also shown are the material type, polarity, manufacturer and indication of use or application.

HOW TO IDENTIFY UNMARKED ICS
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This chart shows the reader how, with just a test-meter, to go about recording the particular 'signature' of an unmarked IC which should enable the IC to be identified with reference to manufacturers or other data.

electronics for beginners

BEGINNERS HANDBOOK OF IC PROJECTS
74286P **$19.25**
The novice is guided in mastering the fundamentals of building, troubleshooting and testing electronic projects. In addition to many elementary projects, more advanced ones are included concerning bipolar integrated circuits and medium and large-scale integrated circuits.

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Data for building corner reflex, bass reflex, exponential horn, folded horn, tuned port, Klipschorn labyrinth, tuned column, loaded port and multi speaker panoramics. Clear dimensioned diagrams included.

SOLID STATE NOVELTY PROJECTS
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A number of novelty projects using modern ICs and transistors. Includes 'Optomin' — a musical instrument played by reflecting a light beam with your hand, water warbler for pot plants, music tone generator, LEDs and ladders game, touch switch, electronic roulette wheel, etc.

SOLID STATE SHORTWAVE RECEIVERS FOR BEGINNERS
222B **$4.32**
Design and construction of several solid-state shortwave receivers giving high level of performance yet utilising relatively few inexpensive components.

BEGINNERS' GUIDE TO BUILDING ELECTRONIC PROJECTS
227B **$5.12**
Enables total beginners to tackle electronic projects. Includes component identification, tools, soldering, building methods, cases, legends, etc, etc. Practical basic projects are included.

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST
228B **$4.32**
This book supplies the electronics hobbyist with the background knowledge which will exactly suit their specific requirements. Minimum maths.

RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART
BP7 **$1.60**
This large wall chart covers all colour codes in use throughout the world. For all radio and electronic components made in UK, USA, Europe and Japan.

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BP48 **$4.64**
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POPULAR ELECTRONIC PROJECTS
BP49 **$4.96**
A collection of the most popular types of circuits and projects to interest most electronics constructors. The projects cover a wide range and are divided into four basic types: radio, audio, household and test equipment.

BEGINNERS GUIDE TO DIGITAL ELECTRONICS
BP61 **$3.36**
Covers all essential areas including number systems, codes, constructional and sequential logic, analogue/digital/analogue conversion.

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EASY ELECTRONICS-CRYSTAL SET CONSTRUCTION
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For those who wish to participate in the intricacies of electronics more through practical construction than by theoretical study. The circuits are based on those from earlier publications but have been modified to use modern inexpensive components and home wound coils.

IC PROJECTS FOR BEGINNERS
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Especially written for the less experienced hobbyist, and offers a range of fairly simple projects based around a number of popular and inexpensive linear and digital ICs. Complete layout and point-to-point wiring diagrams included.

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Two volumes containing easy projects plus chapters on construction techniques and useful information on components.

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constructional projects general

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BUILD YOUR OWN HI-FI & AUDIO ACCESSORIES
220B **$3.04**
Essential for keen hi-fi and audio enthusiasts. Projects include stereo decoder, three-channel mixer, FET preamp for ceramic pick-ups, mic preamp with adj. bass, stereo dynamic noise limiter, loudspeaker protector, voice-operated relay, etc.

28 TESTED TRANSISTOR PROJECTS
221B **$4.32**
Some circuits are new, others are familiar designs. Projects can be split and/or combined for specialised needs.

50 CMOS PROJECTS
224B **$4.64**
Many interesting and useful projects — multivibrators, amplifiers and oscillators; trigger devices; special devices.

MAJOR SOLID STATE AUDIO HI-FI PROJECTS
BP29 **$3.04**
Three projects for the more experienced constructor: 12.5 W/ch stereo amplifier, eight input stereo/mono mixer and 4x14 W quadraphonic amplifier. Full constructional details provided.

HOW TO BUILD YOUR OWN METAL AND TREASURE LOCATORS
BP32 **$5.92**
Electronic and practical details on the simple and inexpensive construction of heterodyne metal locators.

HOW TO MAKE WALKIE-TALKIES
BP43 **$5.12**
This treatise on low power transmitter-receivers (walkie-talkies) covers many aspects from licensing requirements and bands, through practical circuitry and construction to the various types of aerials that may be used.

PROJECTS IN OPTO-ELECTRONICS
BP45 **$5.92**
Included are simple circuits using ordinary LEDs as well as more sophisticated designs such as infra red transmitters and detectors, modulated light transmission and also photographic projects etc.

RADIO CIRCUITS USING ICS
BP46 **$4.64**
This book describes ICs and how they can be employed in receivers for the reception of either amplitude or frequency modulated signals. Also discussed are stereo decoder circuits, quadrophonic circuits and voltage regulator devices.

POPULAR ELECTRONIC PROJECTS
BP49 **$4.96**
Includes a collection of the most popular types of circuits and projects which cover radio, audio, household projects and test equipment.

HOW TO BUILD YOUR OWN SOLID-STATE OSCILLOSCOPE
BP57 **$5.12**
Project divided into sections for builder individually to construct and test — then assemble into complete instrument. Includes short section on scope usage.

SINGLE IC PROJECTS
BP65 **$5.12**
Simple to build projects based on a single IC. A few projects use one or two transistors as well. A strip board layout is given for each project plus special constructional and setting up info. Contents include low level audio circuits, audio power amps, timers, op-amps and miscellaneous circuits.

ELECTRONIC GAMES
BP69 **$5.92**
A number of interesting electronic games projects using ICs for both the beginner and advanced enthusiast.

ELECTRONIC HOUSEHOLD PROJECTS
BP71 **$5.92**
Most useful and popular projects for use around the home. Includes two-tone buzzer, intercom, smoke and gas detectors, baby alarm, freezer alarm etc. etc.

REMOTE CONTROL PROJECTS
BP73 **$6.56**
Covers radio, infra-red, visible light, ultrasonic controls. Full explanations are provided so that the reader can adapt the projects for domestic and industrial as well as model use.

POWER SUPPLY PROJECTS
BP76 **$5.92**
This book gives a number of power supply designs, including simple unstabilised types, fixed voltage regulated types and variable voltage stabilised designs. The designs are all low voltage types for semiconductor circuits.

POPULAR ELECTRONIC CIRCUITS — BOOK 1
BP80 **$6.56**
Yet more circuits from Mr. Penfold! Includes audio, radio, test gear, music projects, household projects and many more. An extremely useful book for all hobbyists, offering remarkable value for the designs it contains.

ELECTRONIC PROJECTS USING SOLAR CELLS
BP82 **$6.56**
Includes a number of projects that benefit from solar power and obviate the problems encountered with batteries, such as weight and bulk, frequency of replacement, and failure when batteries are exhausted.

DIGITAL IC PROJECTS
BP84 **$6.56**
Companion to No. 225 Practical Introduction to Digital ICs and BP61 Beginner's Guide to Digital Electronics. The projects included in this book range from simple to more advanced projects — some board layouts and wiring diagrams are included.

AUDIO PROJECTS
BP90 **$6.56**
Covers a wide range of audio projects including pre-amplifers and mixers, power amplifiers, tone controls and matching etc. A number of board layouts and wiring diagrams are included.

LOOK! More books!

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ELECTRONIC TIMER PROJECTS
BP93 **$6.56**
These may have a high degree of accuracy with quartz control or they may be quite simple designs, using only a few components. A number of specialist timer projects are car windscreen wiper delay unit, darkroom timer, metronome etc.

ELECTRONIC PROJECTS FOR CARS AND BOATS
BP94 **$6.56**
Fifteen fairly simple projects designed for use with 12 V electrical systems but in some cases can also be employed with 6 V and/or positive earth systems as well.

MODEL RAILWAY PROJECTS
BP95 **$6.56**
Projects include such things as controllers, signals and sound effects units. Construction stripboard layouts are provided for each project.

CB PROJECTS
BP96 **$6.56**
A number of useful designs include a speech processor, interference filters and a simple CB radio receiver. Stripboard layouts, wiring diagrams and notes on construction are provided.

POPULAR ELECTRONICS CIRCUITS — BOOK 2
BP98 **$7.52**
A companion for BP80, this book provides a wide range of designs for electronics enthusiasts who are capable of producing working projects from just a circuit diagram without the aid of detailed constructional information.

MINI-MATRIX BOARD PROJECTS
BP99 **$6.56**
This book provides a selection of 20 useful circuits which can all be built on a mini-matrix board which is just 24 holes by 10 copper strips in size. Simple and easy for those with not much experience in electronics.

MULTI-CIRCUIT BOARD PROJECTS
BP103 **$6.56**
All circuits are based on one specially designed pc board. Recommended to the less experienced hobbyist.

ELECTRONIC SCIENCE PROJECTS
BP104 **$7.52**
These projects range in complexity from a simple colour temperature meter to an infra-red laser. There is an electronic clock regulated by a resonating spring and an oscilloscope with a solid-state display. How to build them and use them is fully explained.

AERIAL PROJECTS
BP105 **$6.56**
Practical aerial designs including active, loop and ferrite which are relatively simple and inexpensive to build. The complex theory and mathematics of aerial design have been avoided.

MODERN OP-AMP CIRCUITS
BP106 **$6.56**
A collection of widely varying circuits and projects based on the op-amp ICs.

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
BP110 **$6.56**
Helps you to overcome the problems of a circuit that doesn't work by indicating how and where to start looking for many of the common faults that can occur when building up a project.

circuit techniques and design

TTL COOKBOOK
21035P **$17.50**
A complete look at TTL logic circuits — what TTL is, how it works, and how to use it. Many kinds of practical TTL are included, such as digital counters, electronic stopwatches, digital voltmeters, etc.

ACTIVE-FILTER COOKBOOK
21168P **$21.95**
Learn how to construct filters of all kinds — highpass, lowpass, bandpass. The book is easy to understand — no advanced maths or obscure theory is used.

ELECTRONIC CIRCUITBOOK 1: PROJECT CONSTRUCTION
21241P **$7.50**
Your basic guide to project construction, covering component identification, power supplies, proper tool selection, troubleshooting techniques, oscilloscope use, custom-made enclosures, and more.

CMOS COOKBOOK
21398P **$19.25**
This book explains CMOS technology and its application to 'real world' circuitry. A mini-catalogue is included, which lists over 100 devices, giving their pinouts and application notes.

IC TIMER COOKBOOK
21416P **$15.95**
Gives you a look at the hundreds of ways IC timers are used in electronic instrumentation.

IC CONVERTER COOKBOOK
21527P **$20.75**
Written for the practising engineer, technician, hobbyist or student, this book will be an invaluable working guide to the understanding and use of IC analogue/digital and digital/analogue converters.

DESIGN OF OP-AMP CIRCUITS, WITH EXPERIMENTS
21537P **$16.50**
The design of the fundamental circuits that are the basic building blocks of more sophisticated systems. A series of 35 experiments illustrates the design and operation of linear amps, differentiators and integrators, voltage and current converters, active filters, and lots more.

555 TIMER APPLICATIONS SOURCE BOOK, WITH EXPERIMENTS
21538P **$11.25**
This book describes the construction of the 555 timer and gives numerous practical examples of its applications in all areas of electrical and computer engineering, including 17 simple experiments.

DESIGN OF ACTIVE FILTERS WITH EXPERIMENTS
21539P **$15.95**
Introduction to the theory, implementation and design of active filters using the 741 op-amp.

DESIGN OF PHASE-LOCKED LOOP CIRCUITS, WITH EXPERIMENTS
21545P **$15.95**
An excellent introduction to the theory, design and implementation of phase-locked loop circuits using various TTL and CMOS devices. Includes manufacturers' data sheets and describes the use of breadboarding aids in the wide range of laboratory-type experiments.

AUDIO IC OP-AMP APPLICATIONS
21558P **$13.25**
This book discusses IC op-amps and their application in audio systems, and describes the numerous advantages of using op-amps, including small spatial needs, low power consumption, reliable performance and low cost. Assumes a basic understanding of op-amp theory.

UNDERSTANDING CMOS INTEGRATED CIRCUITS
21598P **$9.95**
This book tells you what CMOS ICs are, how they work, and how they can be used in electronic circuit designs. Many practical circuits, complete with parts values, are included.

DESIGN OF TRANSISTOR CIRCUITS WITH EXPERIMENTS
21626P **$20.75**
A self-teaching course to provide the background and explanations necessary to teach the reader the art of designing transistor circuits.

GUIDE TO CMOS BASICS, CIRCUITS, AND EXPERIMENTS
21654P **$14.95**
If you are already familiar with TTL devices and are ready to examine the benefits of CMOS, this book is your complete source. It tells you what CMOS devices are, their characteristics and design rules. 22 experiments demonstrate the concepts discussed.

PRACTICAL TRANSFORMER DESIGN HANDBOOK
21657P **$35.50**
An easy to understand, illustration-filled guide to designing and constructing transformers. Reviews the fundamentals of electricity, magnetism and algebra needed to understand transformer theory, and covers general design considerations, transformer types, power losses and transformer use in converters and inverters.

Z80 MICROCOMPUTER DESIGN PROJECTS
21682P **$20.75**
This book provides a complete look at the internal architecture of the Z80, the heart of many microcomputers, and even shows how to build a microcomputer, the EX80, using this powerful chip.

DESIGN OF VMOS CIRCUITS, WITH EXPERIMENTS
21686P **$17.50**
The authors look at the technology which makes dramatic advancements possible with VMOS, and show how these components can easily and effectively be integrated into common circuit designs to enhance their responses.

IC OP-AMP COOKBOOK
21695P **$23.75**
Basic op-amp theory in detail, with 200 practical, illustrated circuit applications: JFET and MOSFET units are featured, plus manufacturers' data sheets and company addresses.

EXPERIMENTS IN ARTIFICIAL INTELLIGENCE FOR SMALL COMPUTERS
21785P **$13.25**
Artificial intelligence is the capability of a device to perform functions normally associated with human intelligence. With this book, a small computer with extended BASIC and some knowledge of BASIC language, you can conduct interesting and exciting experiments in artificial intelligence.

PRACTICAL SOLID-STATE CIRCUIT DESIGN
21787P **$14.95**
An introductory course in practical solid-state circuit design for the experimenter, designer or technician who is interested in constructing tailor-made circuits.

SCRS AND RELATED THYRISTOR DEVICES
21806P **$19.25**
Written for experimenters, technicians and engineers, this book is a practical and comprehensive guide to theory, operation, specifications and applications of silicon-controlled rectifiers (SCRs) and related thyristor devices.

REGULATED POWER SUPPLIES
21808P **$29.75**
Comprehensive discussion of the internal architecture and operation of the latest solid-state regulators. Explains when regulated supplies are needed and how to incorporate them in your projects, and discusses modern circuitry including linear and switching circuits and late ICs.

ANALOG INSTRUMENTATION FUNDAMENTALS
21835P **$29.75**
Numerous practical, hands-on lab experiments and solved problems are included, plus discussions of movements, dc ammeters, voltmeters, ohmmeters, bridges, filters and attenuators. No calculus is required.

RF CIRCUIT DESIGN
21868P **$33.95**
A practical approach to the design of RF amplifiers, impedance-matching networks and filters. Uses a minimum of complex maths.

SOLAR CELLS
22270P **$37.95**
In-depth description of the basic operating principles and design of solar cells. It also covers the techniques currently used to produce solar cells and reviews system applications.

ELECTRONIC DESIGN WITH OFF-THE-SHELF ICS
50274P **$14.70**
It contains virtually all the information you need to design and build electronic circuits, systems and subsystems with readily available ICs. Shows how to interface them into highly complex systems.

MODERN FILTER DESIGN
94663P **$49.95**
This book details the advances in active RC filters, both from a practical standpoint and from a state-of-the-art point of view. It is the first book that gives detailed analysis and design procedures for switched capacitor filters.

COIL DESIGN AND CONSTRUCTION MANUAL
160B **$6.56**
How to make RF, IF, audio and power coils, chokes and transformers. Maths is simplified.

50 PROJECTS USING CA3130 ICS
223B **$4.32**
The CA3130 is an advanced operational amplifier capable of higher performance than many others: circuits often need fewer ancillary components. Audio projects. RF projects. Test equipment. Household projects. Misc. projects.

PRACTICAL INTRO TO DIGITAL ICS
225B **$4.32**
Introduction to digital ICs (mainly TTL 7400). Besides simple projects, includes logic test set to identify and test digital ICs. Also includes digital counter-timer.

50 CIRCUITS USING GERMANIUM, SILICON AND ZENER DIODES
BP36 **$3.36**
50 interesting and useful circuits and applications using the germanium and silicon signal diodes, silicon rectifier diodes and zener diodes etc.

50 PROJECTS USING RELAYS, SCRS AND TRIACS
BP37 **$5.92**
Practical working circuits using silicon controlled rectifiers, relays and bi-directional triodes. With a minimum of difficulty you can use them in motor control, dimming and heating control, timing and light sensitive circuits, warning devices and many others.

50 FET PROJECTS
BP39 **$5.92**
Projects include amplifiers and converters, test equipment, tuners, receivers and receiver aids, mixers and tone controls etc etc. The FET used is not critical. This book is of interest and value to SW listeners, radio amateurs, hi-fi enthusiasts and general experimenters.

50 SIMPLE LED CIRCUITS
BP42 **$3.36**
50 interesting and useful circuits and applications using the LED. Also includes circuits for the 707 Common Anode Display for the beginner and advanced enthusiast.

IC555 PROJECTS
BP44 **$6.56**
One wonders how life went on before the 555! Included are basic and general circuits, motor car and model railway circuits, alarms and noise makers plus section on subsequent 556, 558 and 559s.

PROJECTS IN OPTO-ELECTRONICS
BP45 **$5.92**
Included are simple circuits using ordinary LEDs as well as more sophisticated designs such as infra-red transmitters and detectors, modulated light transmission and also photographic projects etc.

RADIO CIRCUITS USING ICS
BP46 **$4.64**
This book describes ICs and how they can be employed in receivers for the reception of either amplitude or frequency modulated signals. Also discussed are stereo decoder circuits, quadrophonic circuits and voltage regulator devices.

LM 3900 IC PROJECTS
BP50 **$4.64**
Unlike conventional op-amps, the LM 3900 can be used for all the usual applications as well as many new ones. It's one of the most versatile, freely obtainable and inexpensive devices around. This book provides the groundwork for simple and advanced uses — it's much more than a collection of projects. Very thoroughly recommended.

50 CIRCUITS USING 7400 SERIES ICS
BP58 **$5.12**
50 interesting and useful circuits and applications using these inexpensive and versatile devices.

50 CMOS IC PROJECTS
224B **$4.64**
Projects include multivibrators, amplifiers and oscillators, trigger devices and other special devices.

SECOND BOOK OF CMOS IC PROJECTS
BP59 **$5.12**
Leading on from book number 224 '50 CMOS IC PROJECTS', this second book provides a further selection of useful circuits mainly of a fairly simple nature. Contents have been selected to ensure minimum overlap between the two books.

COUNTER DRIVER AND NUMERAL DISPLAY PROJECTS
BP67 **$5.92**
Well-known author F.G. Rayer features applications and projects using various types of numerical displays, popular counter and driver ICs, etc.

VMOS PROJECTS
BP83 **$6.56**
Though primarily concerned with VMOS power FETs and their applications, power MOSFETs are dealt with too, in a chapter on audio circuits. Projects include audio circuits, sound generator circuits, dc control circuits and signal circuits.

DIGITAL IC PROJECTS
BP84 **$6.56**
Helps the reader to develop a knowledge of the workings of digital circuits. Board layouts and wiring diagrams are included.

HOW TO USE OP-AMPS
BP88 **$7.52**
Design notes and applications on many topics including basic theory, amplifiers, power supplies, audio circuits, oscillators, filters, computers and control engineering. It's written around the 741 IC but includes design notes for most of the common op-amps.

ELECTRONIC TIMER PROJECTS
BP93 **$6.56**
These may have a high degree of accuracy with quartz control or they may be quite simple designs, using only a few components. A number of specialist timer projects are car windscreen wiper delay unit, darkroom timer, metronome etc.

ETI CIRCUITS BOOKS 1/2/3 **$2.95 ea**
Many of these circuits have been published in the 'Ideas for Experimenters' section in ETI.

ETI CIRCUIT TECHNIQUES VOLS 1/2 **$4.75 ea**
The how, what, which, where, why and how much anthology of electronic components, circuits and techniques.

test equipment and fault finding

AUTOMOTIVE TUNE-UP AND EMISSION CONTROL SERVICE
21712P **$20.75**
Car owners who wish to save money and maintain their cars at peak performance will learn from this book how to adjust, repair and maintain the systems that ensure best operation.

TROUBLESHOOTING WITH THE OSCILLOSCOPE
21738P **$15.95**
Excellent for the professional service technician or the serious hobbyist, as it combines step-by-step procedures for using the scope with the specific nuts and bolts of TV receiver troubleshooting.

EFFECTIVELY USING THE OSCILLOSCOPE
21794P **$14.95**
Excellent for the professional service technician or the serious do-it-yourself, as it combines the correct step-by-step procedures for using a scope with the specific nuts and bolts of TV receiver troubleshooting.

MICROCOMPUTER DESIGN AND TROUBLESHOOTING
21819P **$26.75**
Tells you how to design microcomputer systems and make them work without an expensive commercial development system or the need for costly test instrumentation. The author also provides a complete description of two popular microprocessors — the 8085 and the 6502.

USE OF THE DUAL-TRACE OSCILLOSCOPE
40023P **$23.75**
This programmed text breaks down the process of operating a scope into a series of logical steps starting with the deflection of the electron beam and continuing through proper use of the triggering controls to measure the phase difference between two waveforms.

ELECTRONIC TROUBLESHOOTING HANDBOOK
52585P **$10.50**
This workbench guide shows you how to pinpoint transistor troubles in minutes, how to test almost everything electronic and how to get the most out of low cost test equipment.

PRACTICAL REPAIR AND RENOVATION OF COLOUR TVS
BP34 **$4.32**
This book shows how to obtain a working colour TV for very little outlay by repairing and renovating a set that has been 'written off' by a dealer. Includes practical details of how to construct your own CRT tester/rejuvenator and cross hatch generator.

HOW TO BUILD YOUR OWN SOLID STATE OSCILLOSCOPE
BP57 **$5.12**
The oscilloscope is divided into various sections which can be individually constructed and tested and then assembled together to complete the whole instrument. Also tells you how to use the instrument.

TRANSISTOR RADIO FAULT-FINDING CHART
BP70 **$1.92**
Used properly, this chart should enable the reader to trace most common faults quickly. Across the top of the chart are four rectangles containing brief descriptions of the faults. Selecting the appropriate fault, the reader simply follows the arrows and carries out the suggested checks in sequence until the fault is cleared.

ELECTRONIC TEST EQUIPMENT CONSTRUCTION
BP75 **$5.92**
Describes construction of wide range of test gear including FET amplified voltmeter, resistance bridge, field strength indicator, heterodyne frequency meter etc.

POWER SUPPLY PROJECTS
BP76 **$5.92**
Includes simple unstabilised types, fixed voltage regulator types and variable voltage stabilised designs. The designs are all low voltage types for semiconductor circuits.

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
BP110 **$6.56**
Helps you to overcome the problems of a circuit that doesn't work by indicating how and where to start looking for many of the common faults that can occur when building up a project.

TEST GEAR — METERING AND POWER SUPPLY PROJECTS **$3.00**
Includes many types of meters, audio noise and signal generators, simple CMOS tester, oscilloscope calibrator etc.

TEST GEAR — VOL. 2 **$3.95**
Projects include audio oscillator, transistor tester, true RMS voltmeter, RF signal generator, versatile logic test probe, microwave oven leak detector etc.

ELECTRONIC PROJECTS FOR YOUNG SCIENTISTS **$3.95**
PH meter, geiger counter, helium-neon laser, sound level meter, solar cells, negative ion generator and much more.

electronic music/audio/video

AUDIO CYCLOPEDIA
20675P **$66.00**
A complete in-depth look at the art of audio — from the basic principles of sound to solid-state and integrated circuits. Over 3000 entries and hundreds of illustrations and circuit diagrams cover acoustics, amplifiers, recording, reproduction, test equipment, audio measurements, and much more.

ELECTRONIC MUSIC CIRCUITS
21833P **$24.95**
How to build a custom electronic music synthesiser, outlines numerous other circuit designs and then shows you how to modify them to achieve particular responses. Many of the circuits can be used as special-effects boxes for guitars and other musical instruments.

INTRODUCTION TO ELECTRO-ACOUSTIC MUSIC
81515P **$15.95**
This book assumes no previous technical knowledge. It discusses the relationship between the technology and the composition of electro-acoustic music.

MODERN RECORDING TECHNIQUES
21037P **$19.25**
Explains the equipment controls and techniques found in a modern recording studio and how to use them creatively and correctly to produce a desired result. Numerous photographs, diagrams and charts.

SOUND SYSTEM ENGINEERING
21156P **$32.50**
Dealing with audio systems as a whole, it includes installing and equalising the sound system and interfacing the electrical and acoustic systems. Instrumentation, the acoustic environment and designing for acoustic gain are covered.

TUBE SUBSTITUTION HANDBOOK
21746P **$8.75**
Complete, accurate, up-to-date guide to direct substitutes for receiving and picture tubes. Contains over 6000 receiving tube substitutes, over 4000 monochrome and colour picture tube substitutes, and 600 communications substitutes. Also includes pinouts for quick operational checks.

HOW TO BUILD SPEAKER ENCLOSURES
20520P **$8.75**
A practical guide to the 'whys' and 'hows' of constructing high-quality top-performance loudspeaker enclosures.

ACTIVE-FILTER COOKBOOK
21168P **$21.95**
Learn how to construct filters of all kinds — highpass, lowpass, bandpass. The book is easy to understand — no advanced maths or obscure theory is used.

DESIGN OF ACTIVE FILTERS WITH EXPERIMENTS
21539P **$15.95**
Introduction to the theory, implementation and design of active filters using the 741 op-amp.

AUDIO IC OP-AMP APPLICATIONS
21558P **$13.25**
This book discusses IC op-amps and their application in audio systems, and describes the numerous advantages of using op-amps, including small spatial needs, low power consumption, reliable performance and low cost. Assumes a basic understanding of op-amp theory.

VIDEO TAPE RECORDERS
21521P **$17.50**
In this completely revised second edition, the author tells in simple language how helical VTRs work and how to operate and service them. Includes numerous examples of circuits and mechanical systems.

OOPS! More books!

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CHEAP VIDEO COOKBOOK
21524P **$11.75**
Complete discussion of a new, low-cost way to get words, pictures and opcode out of your computer and onto any ordinary TV screen, using a seven-IC easy-to-build circuit which you can build for less than $20.

AN INTRODUCTION TO VIDEO
BP100 **$6.56**
This book is written in layman's language and is for anyone who is thinking about buying or renting or who has just bought or rented a video recorder and wants to get the best out of the machine.

MOBILE DISCO HANDBOOK
BP47 **$4.64**
Most people who start mobile discos know little about equipment or what to buy. This book assumes no preliminary knowledge and gives enough info to enable you to have a reasonable understanding of disco gear.

ELECTRONIC MUSIC AND CREATIVE TAPE RECORDING
BP51 **$5.92**
Shows how electronic music can be made at home with the simplest and most inexpensive of equipment. Describes how the sounds are generated and how these may be recorded to build up the final composition.

PRACTICAL CONSTRUCTION OR PREAMPS, TONE CONTROLS, FILTERS, ATTENUATORS
BP60 **$4.96**
This book shows the enthusiast how to construct a variety of magnetic tape recording, microphone and disc preamplifiers, and also a number of tone control circuits, rumble and scratch filters, attenuators and pads.

ELECTRONIC SYNTHESISER PROJECTS
BP81 **$5.92**
For the electronic music enthusiast, an invaluable reference. This book is full of circuits and information on how to build analogue delay lines, sequencers, VCOs, envelope shapers, etc. etc. The author takes a clear and logical approach to the subject that should enable the average enthusiast to understand and build up what appears to be a quite complex instrument.

AUDIO PROJECTS
BP90 **$6.56**
Covers a wide range of audio projects including preamplifiers and mixers, power amplifiers, tone controls and matching etc. A number of board layouts and wiring diagrams are included.

ELECTRONIC MUSIC PROJECTS
BP74 **$5.92**
Provides constructors with practical circuits for the less complex music equipment including fuzz box, waa-waa pedal, sustain unit, reverb and phaser, tremolo generator etc. Text covers guitar effects, general effects, sound generators, accessories.

SONICS 1982 YEARBOOK **$5.35**
An interview with Kraftwerk, how to cope with recording, lighting, rock acoustics, guitars, equipment reviews and more.

SONICS MAGAZINE **$2.35 ea**
The Australian music magazine dedicated to the art and craft of sound. Published April, July, October, Yearbook in December. $15 for one year subscription. Please indicate starting issue.

computers for beginners

COBOL FOR BEGINNERS
39378P **$21.95**
It is a solid text for introductory programming courses in Cobol, using a format that is easy to understand, yet comprehensive enough to make supplementary readings unnecessary.

THE PET PERSONAL COMPUTER FOR BEGINNERS
61827P **$20.95**
This handy guide is written for use with all varieties of PET computer, from the original 2001 to the new 8032 Super PET. It is suited to novices with no practical experience and provides advice and practical examples.

BIG THINGS FROM LITTLE COMPUTERS
77859P **$19.25**
A layperson's guide to personal computing with all the basic information and lots of examples of how personal computers can be used.

BEGINNER'S GUIDE TO DIGITAL ELECTRONICS
BP61 **$3.36**
Covers all essential areas including number systems, codes, constructional and sequential logic, analogue/digital/analogue conversion.

BEGINNER'S GUIDE TO MICROPROCESSORS & COMPUTING
BP66 **$5.92**
Introduction to basic theory and concepts of binary arithmetic, microprocessor operation and machine language programming. Only prior knowledege assumed is very basic arithmetic and an understanding of indices.

A MICROPROCESSOR PRIMER
BP72 **$5.92**
Learning about microprocessors is easy with this book, written in a style that is easy to follow. The shortcomings of this basic machine are discussed and the reader is shown how these are overcome by changes to the instruction set. Relative addressing, index registers follow as logical progressions.

AN INTRO TO BASIC PROGRAMMING TECHNIQUES
BP86 **$6.56**
Ideal for beginners seeking to understand and program in BASIC. Book includes program library for biorhythms, graphing Y against X, standard deviations, regressions, generating musical note sequences, and a card game.

BEGINNING BASIC
39806A **$19.95**
Intended for beginners with no computing experience, one should be able to intelligently program in BASIC in a short time.

BEGINNING FORTRAN
46011A **$19.95**
Starts with simple elementary examples and proceeds to intermediate level programs. Also includes references, tutorials, flow charts, deck set-ups and matrix algebra.

UNDERSTANDING COMPUTERS
39815A **$17.95**
This book describes how computers work. For people who use small computers, it starts with the most elementary gates and works up to the complete computer. Gives an understanding of languages and how they operate in the computer.

NAILING JELLY TO A TREE
39842A **$24.95**
This guide to software teaches you about machine language, assembly language programming and BASIC. The emphasis is not on learning to write programs but on learning to use the thousands of available programs that have already been written.

PEANUT BUTTER AND JELLY GUIDE TO COMPUTERS
39813A **$14.95**
A simple, easy-to-digest source of information on personal computing for the potential buyer who is less than an expert in the field.

INTRODUCTION TO WORD PROCESSING
88076A **$17.95**
Written for the non-technical reader, this book tells about the concepts common to all word processing systems, then analyses all features in detail.

YOUR FIRST COMPUTER
88045A **$12.50**
An easy-to-understand beginner's book to small computers. Understanding them, buying them and using them for personal and business applications.

FROM CHIPS TO SYSTEMS: AN INTRODUCTION TO MICROPROCESSORS
88063A **$19.95**
Explains exactly what a microcomputer system is and how it works. Introduces fundamental concepts and covers all aspects of microprocessors and related components: internal operation, memories, interfacing and system development etc.

COMPUTERS FOR EVERYBODY
39849A **$8.95**
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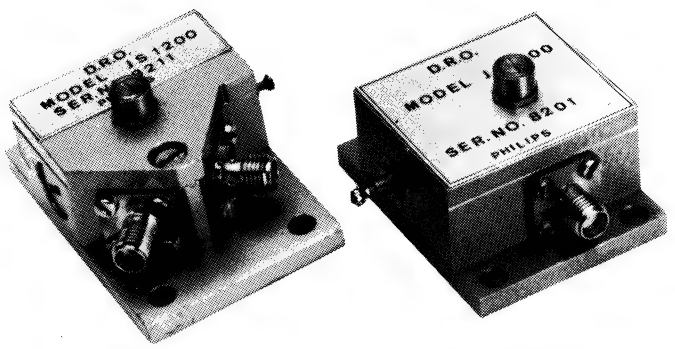


Low-cost stable microwave oscillators

The Philips JS1200 series of low-cost microwave oscillators feature a claimed stability of better than -4×10^{-6}/K.

The oscillators have a size of only 34 x 48 x 44 mm, and are suitable for telecommunications systems, radar beacons, ECM receivers and weather radar.

A Gunn diode is used as the active element in these dielectric resonator-stabilised oscillators (DROs). The high stability, small size and low FM noise (quoted as typically 0.15 Hz in a 1 Hz band at 100 kHz off the carrier) are obtained by using a small, high-Q ceramic resonator as the frequency determining element.

The JS1200 series consists of oscillators with centre frequencies of 9 to 12 GHz; each oscillator can be tuned up to 5% from its centre frequency. The nominal output power is 30 mW and other output powers are available on request.

Versions of the oscillators with two outputs are also available for use with transmitters/receivers needing a common frequency source.

For further information contact **Elcoma, 67 Mars Road, Lane Cove NSW 2066. (02)427-0888.**

Hideaway transceiver suits non-CBers

Tandy Electronics has released a new kind of 'emergency' CB radio to suit people who don't like CB radios!

The Realistic TRC-411 is a 40-channel transceiver that needs no installation so there are no holes to be drilled in your car's bodywork.

The unit fits in a small carrying case which stores in the glove box or under the seat until required for a breakdown or other emergency.

The unit employs a telescopic magnet-base antenna which attaches to the bonnet or roof of the car and has a power cord which plugs directly into the car's cigarette lighter socket.

A single switch is used to place the user on the CB emergency frequency, which is monitored 24 hours a day in most areas by volunteer radio operators belonging to organisations such as CREST who give assistance to motorists.

The monitors can obtain breakdown service from the motoring organisations or fetch the emergency services if you report an accident.

The Tandy emergency radio can also function as a regular

40-channel CB, and be used to talk to other CB-equipped motorists near you.

More than just a practical piece of safety equipment, the Realistic TRC-411 is also ideal for people who wish to have CB communications in a rented or company vehicle, Tandy say. The unit retails for $149.95.

For information, contact David Harvey at **Tandy, P.O. Box 229, Rydalmere NSW 2116. (02) 638-6633.**

Phase 3B Oscar close to launch

Launch of the Phase 3B Oscar satellite looks better and better for April this year, according to overseas' sources.

A firm launch date had not been finalised as we went to press (mid-January) but the launch is mooted to take place in the latter half of the month, probably after the 20th.

The Phase 3B Oscar will be launched from a European Space Agency Arianne L-6 booster, initially going into a 'parking' orbit from where it will be 'kicked' into its final, highly elliptical, orbit by an on-board apogee kick motor.

The highly elliptical orbit is expected to provide inter-continental communications via the VHF and UHF translators to be carried by the satellite.

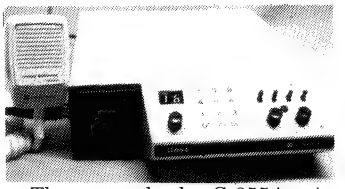
New VHF FM marine radiotelephone

GFS Electronic Imports, the Australian distributors for Standard Communications of Japan, have announced the release of a new VHF Marine Radiotelephone.

Known as the Standard Model C-855A, it is a 55-channel marine transceiver designed to operate on the international VHF FM Seaphone band.

With OTC's Seaphone service a boat operator is able to obtain weather forecasts, talk with any telephone in Australia, communicate with other boats or just keep in touch with a shore base.

The transceiver incorporates keyboard entry of the channels with automatic scanning for up to 10 channels. High priority is given to the emergency channel (Ch. 16) by incorporating a 'dual-watch' facility. Transmitter power output is 25 watts.



The standard C-855A is approved for operation in Australian waters by the department of Communications. Priced at $689 it is claimed to offer small boat owners an economical alternative to other $1000-plus FM and SSB radiotelephones.

For further details contact **GFS Electronic Imports, 15 McKeown Road, Mitcham Vic. 3132. (03)873-3939.**

Largest solar flare in 10 years

The largest solar flare recorded in the past 10 years occurred on December 14 last, bringing a magnetic storm and disrupting communications here on earth the following day.

The flare was given an 'X-12' rating by solar-terrestrial scientists in Boulder, Colorado.

The virtual explosion on the Sun's surface released atomic particles and vast amounts of energy into space — more energy than the Earth uses in an entire year.

'X' is the largest of the three 'classes' of solar flares and a flare of this magnitude has not been noted since the last sunspot peak decline in the early '70s.

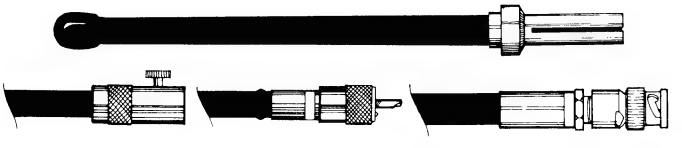
Scanner whips

Do you 'follow the action' with a portable scanner? To pull in those signals from near and far, you need a Benelec mini flexible scanner whip.

Benelec's mini flexible scanner whip is 205 mm long and comes in four base styles to suit most applications. The 2-112 has a push-on sleeve fitting, the 2-113 has a male BNC base, the 2-114 has a PL259 base and the 2-115, a lockscrew base.

The whip is shrouded in black plastic, with a plastic cap on the top, to prevent atmospheric deterioration and physical damage from handling.

Details are available from **Benelec Pty Ltd, P.O. Box 21, Bondi Beach NSW 2026. (02) 665-8211.**



Power FET device delivers 40 W at 400 MHz

FETs have many advantages over bipolar devices, but RF power FETs have been slow to appear and bandwidths have been limited. A new process looks set to change that.

Many designers of power amplifiers choose to incorporate field-effect transistors instead of bipolar devices because the FETs are easier to use. FETs have a large safe-operating area; their negative temperature coefficient means they are not prone to thermal runaway; and they are voltage-operated instead of current-driven, so they are easier to bias and modulate.

Their limitation has been frequency range — power FETs have not been able to manage more than about 200 MHz.

But a new process developed by Acrian Inc. has pushed the FET bandwidth frontier outward, and the company has come out with what is said to be the first commerically available UHF power FET, the UMIL40FT.

Built with a process called Isofet, the new device is actually two transistors connected in a push-pull configuration.

Acrian claim it delivers 40 W with 20 dB gain, flat within ±0.5 dB over the octave from 200 to 400 MHz. Greater bandwidths are achieved at lower power levels: at a 30 W output, the output is flat within ±1.5 dB from 20 to 500 MHz, Acrian claim.

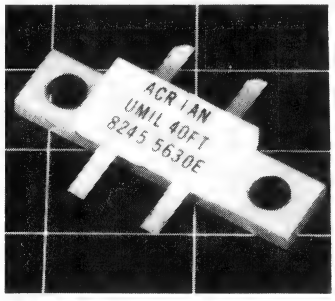
Applications for the UMIL40FT include communications systems operating in bands covering 2 to 30 MHz, up to 400 MHz, plus broadband instrumentation etc in the 200 to 500 MHz range.

In high-efficiency AM and FM power amplifier and transmitter applications, the device, operating in class B, will put out 40 W with about 800 mW of drive — a gain of 17 dB.

For low-distortion applications it can be operated in a true class-A amplifier configuration without the need for stabilising networks or feedback circuits. In this set-up, it is capable of delivering a 40 W output with 400 mW of drive, or a gain of 20 dB, Acrian say.

Input coupling is also simple — all that is required is a transformer, instead of the complex matching networks employed in bipolar designs, and biasing is accomplished with a resistor. Priced at US$105 in small quantities, the UMIL40FT has a maximum power dissipation of 100 W.

Enquiries to **Acrian Inc, 10131 Bubb Rd, Cupertino, California 95014 USA.**



New grid parabolas from AEA

Antenna Engineering Australia is currently manufacturing a new range of grid parabolic antennas that they claim are lighter in weight than their previous series, offer superior performance and are very competitively priced.

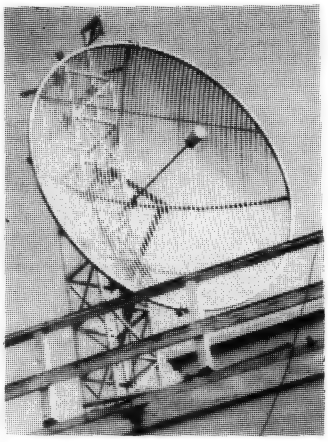
A feature of these antennas is that they are not just unpressurised, but have void-free feeds for greater reliability.

Models are available for operation in the bands 400-500 MHz, 820-960 MHz, 1427-1535 MHz and 1700-1900 MHz. Antenna sizes are 1.8 m, 2.4 m, 3.0 m, 3.7 m and 4.6 m.

All antennas are rated at 200 km/hr calculated in accordance with Australian Standard AS1170. Higher wind ratings are available. Construction is welded corrosion resistant aluminium of the 6000 series.

The antennas are manufactured in two halves to reduce transportation costs and handling difficulties.

AEA has a full parabolic 'GRIDKIT' type barabolic antenna going into production shortly, designed for field assembly.



For further information contact **Antenna Engineering Australia Pty Ltd, P.O. Box 191, Croydon Vic. 3136. (03)728-1777.**

Russian ISKRA 3 satellite active

Like the ill-fated ISKRA 2 satellite launched last May (see ETI, July '82, page 67), ISKRA 3 was launched from the orbiting Solyut 7 space station by pushing it through the airlock.

The launch took place on 18 November last year. Approximate orbital parameters are: period — 92 minutes, inclination — 52°, apogee — 365 km, perigee — 350 km.

The callsign on its 29.583 MHz beacon is RK-03. ISKRA 3 carries a 15m-to-10m transponder, as did ISKRA 2. Life expectancy of this new satellite is believed to be between two and three months in orbit. ●

JAYCAR NUMBER 1 FOR VIDEO

WE HAVE THE BIGGEST RANGE OF VIDEO ACCESSORIES!

VJ-104-CY

Check out our great range of video connector cables! Ideal for video - to - video dubs!
BNC plug - BNC plug 1.5m coax Part No. VC-1 $6.95
BNC plug - PL259 .1.5m coax Part No. VC-2 $6.95
PL259 — PL259 1.5m coax Part No. VC-3 $4.95
PL259 - RCA plug (metal) 1.5m of coax Part No. VC-4 $5.95
RCA plug - RCA plug (metal) 1.5 metre coax Part No. VC-5 $4.95
BNC plug - RCA plug (metal) 1.5 metre coax Part No. VC-6 $5.95
Sanyo (6 pin DIN plug) to 2.5 & 3.5 RCA plug Part No. VC-8 $8.95
(all coax 75 ohms)

PLUG ADAPTORS

PA21 PL259 plug to RCA socket $2.95
PA22 PL259 plug to BNC socket $3.95
PA23 BNC plug to RCA socket $3.95
PA24 SO239 socket to BNC plug $3.95

TV ACCESSORIES

FL-1 Coax (75 ohms) fly lead Belling Lee coax plug to B/L coax plug 1.8 metres $2.95
FL-4 As above but 4.5m long $4.95
FL-2 Coax lead 1.8m B/L line plug to B/L socket. $3.45

VIDEO SWITCHING BOX

$49.50 Cat. AV6504

LOW LOSS RF SWITCHING
— Allows inputs for; VCR, Video Disc (etc); Antenna, Cable TV, Video Games and Home Computer.
WOW!!!

KEEP YOUR PRECIOUS TAPES IN SAFETY

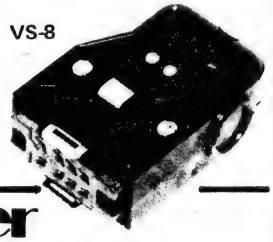
We now stock the Video Cassette tape cases that you see in the video stores. You know, the ones they give you when they hire out the tapes. Take care of your tapes with these quality cases. Each case is precision moulded with a stiff spine. They feature a sleeve on the spine to enable you to insert recording information in an easily seen way.

VHS	Cat. AV6592	$2.95
BETA	Cat. AV6590	$2.95

MORE VIDEO ACCESSORIES

VP-8 8 pin square video connector line plug $7.95
VS-8 8 pin square video line socket $7.95
PA-25 5 pin 180 degree dubbing adaptor. Reverse pins for video use $5.95
VC-15 6 pin DIN plug to 6 pin DIN plug 1.5 metres $4.95
VC-17 5 pin DIN plug to 5 pin DIN plug (reverse pins for video) The plugs are moulded in red to indicate that it is a video connector, 1.5m $4.95
VJ.104CY Video camera cable (bulk) 2 x 75 ohm video, 2 x shielded microphone, 6 other carriers. Designed for BETA but perfectly suitable for VHS. Up to 30 metre lengths. $3.95/metre

VS-8



VIDEO STABILISER Cat. AV6502

As many of you know, many video tapes, — especially from the USA have the sync pulses suppressed to prevent unauthorised copying of the original dub. This process is fine because it hinders unauthorised re-recording (dubbing) of material. It is annoying though when you hire the original and find that the "Copyguard" is causing problems with your TV. The AV6502 re-inserts the sync pulses automatically and restores stability.
WARNING! The AV6502 is intended solely for the use above. Whilst the AV6502 will virtually remove copyguard on a tape copy (and hence restore the picture) it is against the law to unlawfully copy copyright material.
The AV6502 looks almost identical to the AV6500 shown to the right.

ONLY $79.95

Video Enhancer

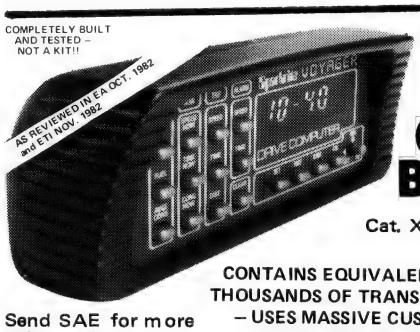
NOT A KIT — BUILT AND TESTED....

$89 Cat. AV6500

Unbelievable but true. This unit enables you to actually IMPROVE a copy of a recorded video tape. How? By amplifying the top end of the video signal by a small amount. This sharpens up the detail of the picture. Dubs can actually look better than the original. Works as a video distribution amplifier as well. Will drive up to 4 VCR's from one VCR input.

magnificent!

COMPLETELY BUILT AND TESTED — NOT A KIT!!



THE BEST CAR COMPUTER BELOW $200

Cat. XC2010

CONTAINS EQUIVALENT OF THOUSANDS OF TRANSISTORS — USES MASSIVE CUSTOM LSI CHIP TO ACHIEVE LOW PRICE

only $199 complete

Send SAE for more information.

IDEAL RALLY COMPUTER!

FEATURES
- INSTANT FUEL CONSUMPTION IN LITRES/100KM AND MPG!! (MOST OTHERS HAVE ONLY ONE OF THE ABOVE) JUST SWITCH FROM ONE TO THE OTHER AS YOU DRIVE ALONG.
- INSTANT SPEED, TIME AND OTHER FUEL DATA.
- VISUAL AND AUDIBLE EXCESS SPEED ALARM.

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MAIL ORDERS TO: BOX K-39 HAYMARKET, SYDNEY 2000

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$25 – $49.99 ($4.50) $50 – $99.99 ($6.50)
$100 up ($8.00)

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Mon – Fri 8.30 to 5.30pm
Sat 8.30 to 12.00pm
Thurs night to 8.30pm

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THE BEST KIT LINE

YOUR WAGES ARE FROZEN, OURS ARE TOO. SO ARE OUR KIT PRICES – QUALITY FOR NO MORE!

LOW COST DIGITAL MULTIMETER KIT

BY POPULAR DEMAND

Ref: EA March 1983 (This month)
Almost everyday we are asked for a multimeter kit. Up until now we thought that it was just not worth it considering the fine low-cost built-up units available. The DP2010 changed all that.
This kit, fully imported from the UK uses the famous DPM-05 custom LCD/Voltmeter to achieve phenomenal accuracy at very modest cost!
All parts are included to complete the meter including an attractive and colourful front panel.
(a 9V battery is required)

Set of test probes to suit $2.95
Probe to suit Cat. WT5312 ONLY $2.50
Eveready 216 (red) 9V Battery Cat. SB2370 ONLY $1.40

ONLY $45

DP2010 kit Cat. KJ7010
ONLY $45

SPECIFICATIONS

Function	f.s.d.	Resolution	Accuracy	Protection
Volts (d.c.)	2V	1mV	1% ± 1 digit	500V for
	20V	10mV	1% ± 1 digit	one minute
	200V	100mV	1% ± 1 digit	
	500V	1V	1% ± 1 digit	
Current (d.c.)	2mA	1uA	1% ± 1 digit	1A/250V
	20mA	10uA	1% ± 1 digit	
	200mA	100uA	3% ± 1 digit	
	2000mA	1mA	5% ± 1 digit	
Volts (a.c.)	2V	1mV	2% ± 5 digit	500V for
	20V	10mV	2% ± 5 digit	one minute
	200V	100mV	2% ± 5 digit	
	500V	1V	2% ± 5 digit	
Current (a.c.)	2mA	1uA	2% ± 5 digit	1A/250V
	20mA	10uA	2% ± 5 digit	
	200mA	100uA	4% ± 5 digit	
	2000mA	1mA	7% ± 5 digit	
Resistance	2K	1	1% ± 1 digit	260V
	20K	10	1% ± 1 digit	r.m.s.
	200K	100	1% ± 1 digit	
	2000K	1K	1% ± 1 digit	
Diode Test	2V	1mV	1% ± 1 digit	260V r.m.s.

AC VOLTAGE AND CURRENT RANGES
When S3a selects a.c. functions the output from either the voltage attenuator or current shunts is fed through C1 to remove any d.c. component.

500MHz Digital Frequency Period Meter

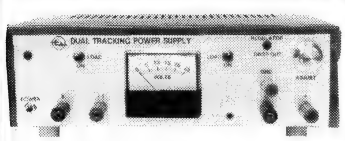
REF: EA Dec '81 – Feb '82

ONLY $119

EXCLUSIVE
Gold plated BNC Input Connectors
500MHz option only $26 extra KA1392
50MHz version $119 Cat. KA1390
Tilting bail to suit ONLY $4.95

Other people may appear to be selling this kit for less. But you GET less!!!
Exclusive Jaycar features:
* Heavy gauge front panel. Pre-punched and silkscreened. (NOT Scotchcal). * Low aging rate 10.000MHz crystal * Quality IC sockets provided (A MUST) * All metal film resistors used (1% 50ppm) * Thermalloy heatsink for +5V reg.
Beware of advertised units that do not conform to the original design. They may have inferior performance.

EA dual tracking P/S



Extremely versatile power supply: Will give plus & minus 1.3V to 22V at up to 2 amps PLUS A FIXED +5V@0.9A. The supply is completely protected against short circuits, overloads and thermal runaway. A large meter with voltage calibration is supplied as well as IC sockets. A quality kit.

Ref: EA March '82
Cat. KA1410 **$89.50**

STEREO STEREO STEREO STEREO

Synthesiser

Creates a very realistic stereo sound from mono sources i.e. AM tuners, TV or video units Very easy to build and comes complete.

Short Form Version Only $39.50
Cat. KA1476

Ref: EA September 1982

COMPLETE ONLY **$49.50**
Cat. KA1478

HEART RATE MONITOR

Ref: EA 7/82

This unit enables you to measure your own pulse instantly and accurately. It is light enough even for joggers to carry. A must for people who may have heart problems.
Complete kit including LCD Display.

Cat. KA1466

WAS $79 SAVE $10 NOW **$69**

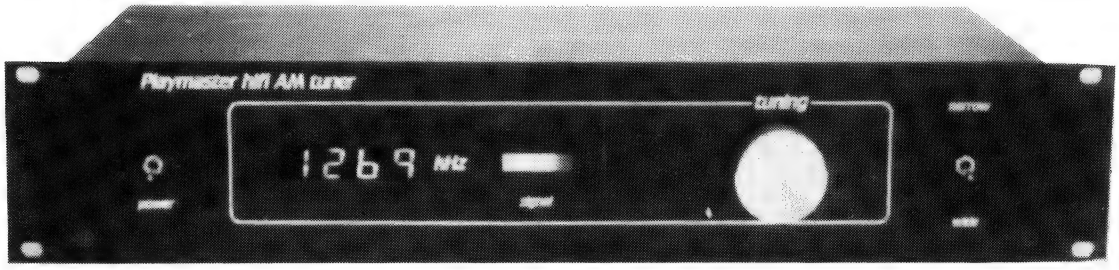
UP IN '83-JAYCAR ✸

CAN AM SOUND LIKE FM? WE THINK SO! ✡ ✡ ✡ ✡ ✡ ✡ ✡

magnificent! NEW EA Wide-band AM Tuner ✡

Ref: EA Dec-Jan 82-83

AM Tuner alignment kit ref: EA March 83 This simple project enables you to accurately align your EA wideband tuner. Cat. KA1515 $7.99



Australia is one of the few countries in the world where wideband AM is transmitted. In fact a good quality AM signal can be much better than its FM counterpart!!
Anyone who has suffered from FM multipath distortion will know what we mean. The Playmaster AM tuner is a true broad-bandwidth superhet design. See the frequency response graph in November EA 1982.
Once again, the Jaycar kit is a high quality approach. Jaycar supplies an exclusive front panel design that differs from the original EA design. The Jaycar kit provides all components to complete the project INCLUDING a completely pre-punched cabinet.

FANTASTIC VALUE AT ONLY **$249**

Cat. KA1498

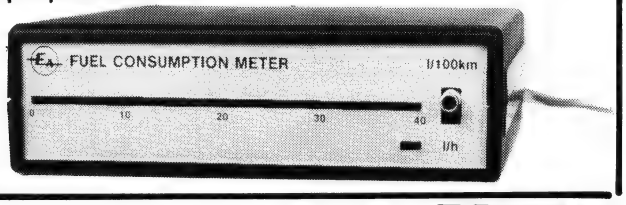
NEW FUEL CONSUMPTION METER ✡ ✡ ✡

Ref: EA March 1983

Now you have NO EXCUSE to monitor the excesses of your driving habits! At this price your fuel cost savings will pay for the unit very quickly!
Kit including all electronics and pre-punched case — Cat. KA1518 $49.50

GENUINE MORAY FUEL SENSOR Cat. XC2020 $69.50

TAILSHAFT SENSOR TO SUIT Cat. XC2026 $14.50



NEW EPROM programmer for the MicroBee

REF: ETI 2/83

Fantastic little accessory for the popular "Microbee" computer.
The Jaycar kit contains all components including the following SPECIAL features:
- 28 pin IC socket included!
- 3 x 16 pin "PERSONALITY PLUG" HEADERS
- 15 pin PARALLEL CONNECTOR
- IC sockets for all logic devices including personality socket.

ALL THIS FOR ONLY $39.95!
Cat. KE4650

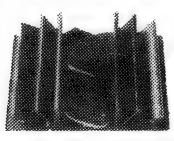
24 pin ZIF socket to suit only $12.95 Cat. PI6522

TRANSISTOR ASSISTED IGNITION NEW

Ref: EA January 1983. Latest version of this fantastically popular kit!! The Jaycar kit comes with a genuine DIE CAST box — as used in the EA prototype. Beware of others that use flimsy sheet metal boxes!! Ask us about the OPTO option.

Cat. KA1506

ONLY **$35**



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$100 up ($8.00)

NEW SHOP HOURS
Mon – Fri 8.30 to 5.30pm
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Thurs night to 8.30pm

Mail Order By BANKCARD
Via Your Phone

Dear Sir,

I write to you re your 'Dregs' column of the November '82 issue of ETI. In this column a cartoon appeared in which the following phrase was significant, *"Ying tong, ying tong, ying tong, ying tong, ying tong yiddle di po."*

As was pointed out by the columnist, followers of the 'legendary' Goon Show will recognise this phrase. I am a devout fan of the Goon Show and did, of course, recognise the phrase you printed as a travesty, a living mockery of the Goons. You see the phrase has been misquoted to such a hideous extent that it can only be seen as a direct insult to the small group of individuals who love the Goon Show.

You see, the actual title of this song which is being referred to is the 'Ying Tong Song' and I have just spent ten minutes listening to my copy of this record and can assure you that the phrase you have printed occurs *nowhere* in the song. The correct form of the lines which are quoted in Dregs is, *"Ying tong, ying tong, ying tong, ying tong, ying tong iddle I po."*

It is obvious that the words 'iddle I' have been misquoted — nay butchered — to give 'yiddle di'. This disgusting oversight can only be seen as a deliberate slight at the lyrical and poetic brilliance of Spike Milligan.

In today's world we are blasted with so much inferior, classless and totally tasteless humour that to *misquote* the work of probably the greatest comedians of our time can only be seen as criminal. Now we are so saturated with the work of immature and mindless talents (such as Monty Python or 'Not the' Nine O'Clock News') that to ignore the work of the great thespians of our past is a crying shame.

I should hope that you will act to correct this disastrous mistake, lest the youth should see such actions continue unbridled and themselves take part. Good God! — you don't go to press with the cover reading 'Electronics Tidly Internuptual', so please don't misquote the Goons. This last comment is expressed with pleading, relish and mustard.

C. Tinney
Beverly Hills, NSW

We fail to be convinced of two things, namely: whether you're the truly devout Goons fan you claim to be, and whether the Ying Tong song goes "yiddle di po" or "iddle I po".

Firstly, a *truly* devout fan of the Goons would have opened with " . . . you rotten swine!", and threatened to send us an exploding rancid porridge bomb through the mail.

Secondly, the week after your letter arrived, by happenstance 2BL's famous breakfast announcer, the inimitable Clive Robertson, played the Ying Tong song immediately following the 7 am news one morning. I turned it up and listened intently. I distinctly heard " . . . ying tong yiddle di po". Further, Clive replayed the falsetto bit at the end of the track at 33 rpm (the record is a 45 rpm EP). The song *definitely* goes " . . . yiddle di po"!

May the string that supports your knickerbockers turn into rotten twine and let your trousers down!

Bluebottle Harrison
Dregs Correspondent
(by appointment)

Dear Sir,

With respect to improving ETI slightly, I would like to see a brief explanation, with each project you publish, of why you used such and such an op-amp or transistor instead of another. Sometimes I look at one of your circuits and ask myself why a BD.. or a BF.. (a bit hard to get) was used when a common old 2N2222 would do as well. And then I try it and it does work. And you like 301s, when perhaps a TL081 might be better.

You have probably been asked this before but in 'How it works' couldn't you add a sentence or two like this 'there are dozens of transistors which will carry 200 mA and have an h_{fe} of 250, but we decided to use ... because X had a sale recently'. You know, the overseas magazine that specifies a TUN or a TUP and elsewhere gives a ruddy great list of such.

Your magazine sells to all sorts of people and I can't answer for others, but I would like to see a bit more analysis and more explanation of your circuits; after all, they are usually your designs and you know why you used a 20k resistor on a back-biased photodiode when my references say a 100k. I conclude, of course, that you know something I don't but maybe it was just a misprint.

N. Hobson
Canterbury, NSW.

Your various points are well taken. We *do* explain, as often as possible, why we have used certain components or designed a circuit a particular way. For example, in the Series 5000 graphic equaliser, published in the November '82 issue, under the section headed 'Design', David Tilbrook explains the choice of the NE5534 and uA774/TL074 op-amps.

In general, when selecting components, particularly semiconductors, we ask ourselves (1) "What will do the job?", (2) "Is it commonly available?", (3) "If not commonly available, is there a reasonable source of supply (and who)?" and (4) "Is it cost effective?". We specify BD and BF transistors because they meet these criteria, 2N2222s would rarely do so (on an Australia-wide basis). We "like" 301s because they too, meet these criteria, particularly with regard to price — 301s cost 50-60 cents and are really widely available, TL081s cost more than that and are nowhere near as widely available. In any case, the Shoparound page serves to indicate component kit suppliers for current projects. We don't like suggesting 'substitutes' unless they are *tried and known.* Semiconductor tolerances can be so broad between supposedly equivalent types that, from bitter experience, it is either impossible to design for, negates the point or degrades the performance of a circuit. We do not specify a particular device ". . . because X had a sale recently". Projects have a lifetime longer than the life of 'special sales'. We are aware of the practice *Elektor* uses when specifying components — the TUP (transistor-universal-pnp), TUN (transistor-universal-npn) etc. We looked into this very carefully but, for the reasons stated above, and from long experience, we consider the practice unwise. For example, with the ETI-330 Car Alarm (July '81), the 4093B specified for IC3 would not perform in the reset mode as described in the article because *some* devices of *some* manufacturers had distinctly differing performance parameters from those specified for the device of a particular manufacturer we used in the prototypes. (The cure, incidentally, is to change R6 to 100k and C2 to 10n). That's one hell of a trap! Surely a 4093 is a 4093 is a 4093 . . . ? Apparently not. ▶

Dear Sir,

I write to you re your 'Dregs' column of the November '82 issue of ETI. In this column a cartoon appeared in which the following phrase was significant, *"Ying tong, ying tong, ying tong, ying tong, ying tong yiddle di po."*

As was pointed out by the columnist, followers of the 'legendary' Goon Show will recognise this phrase. I am a devout fan of the Goon Show and did, of course, recognise the phrase you printed as a travesty, a living mockery of the Goons. You see the phrase has been misquoted to such a hideous extent that it can only be seen as a direct insult to the small group of individuals who love the Goon Show.

You see, the actual title of this song which is being referred to is the 'Ying Tong Song' and I have just spent ten minutes listening to my copy of this record and can assure you that the phrase you have printed occurs *nowhere* in the song. The correct form of the lines which are quoted in Dregs is, *"Ying tong, ying tong, ying tong, ying tong, ying tong iddle I po."*

It is obvious that the words 'iddle I' have been misquoted — nay butchered — to give 'yiddle di'. This disgusting oversight can only be seen as a deliberate slight at the lyrical and poetic brilliance of Spike Milligan.

In today's world we are blasted with so much inferior, classless and totally tasteless humour that to *misquote* the work of probably the greatest comedians of our time can only be seen as criminal. Now we are so saturated with the work of immature and mindless talents (such as Monty Python or 'Not the' Nine O'Clock News') that to ignore the work of the great thespians of our past is a crying shame.

I should hope that you will act to correct this disastrous mistake, lest the youth should see such actions continue unbridled and themselves take part. Good God! — you don't go to press with the cover reading 'Electronics Tidly Internuptual', so please don't misquote the Goons. This last comment is expressed with pleading, relish and mustard.

C. Tinney
Beverly Hills, NSW

We fail to be convinced of two things, namely: whether you're the truly devout Goons fan you claim to be, and whether the Ying Tong song goes "yiddle di po" or "iddle I po".

Firstly, a *truly* devout fan of the Goons would have opened with " . . . you rotten swine!", and threatened to send us an exploding rancid porridge bomb through the mail.

Secondly, the week after your letter arrived, by happenstance 2BL's famous breakfast announcer, the inimitable Clive Robertson, played the Ying Tong song immediately following the 7 am news one morning. I turned it up and listened intently. I distinctly heard " . . . ying tong yiddle di po". Further, Clive replayed the falsetto bit at the end of the track at 33 rpm (the record is a 45 rpm EP). The song *definitely* goes " . . . yiddle di po"!

May the string that supports your knickerbockers turn into rotten twine and let your trousers down!

Bluebottle Harrison
Dregs Correspondent
(by appointment)

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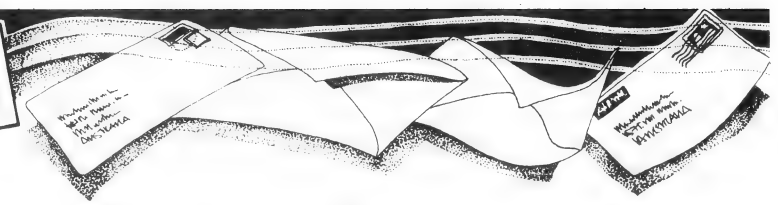
LETTERS



If you *must* search out component equivalents, then best arm yourself with a stack of different manufacturers' data books and some knowledge of circuit analysis. For transistors and FETs, one of the best books is National Semiconductor's *Transistors/FETs, small signal, power.* This lists devices in familiar tabular form, and the rear section has the characteristics of devices listed by *Process Number.* 'Equivalents' can be found by matching process numbers. The 2N2222, for example, is a process 20 (npn medium power) transistor, described as a "non-overlay double diffused, gold doped, silicon epitaxial device. Complement to Process 63." Other process 20 devices are MPS3642, 2N3641/42/43. That's all very well, but in some circumstances, the circuit may not tolerate a different tolerance range on some parameter or another — some of which may be due to the particular package.

As for more circuit analysis and why we used 20k where your reference shows 100k, we include such things where it seems warranted, but I'm afraid project descriptions would get very lengthy, if not tedious, if we did it all the time covering every minute detail. Besides, it's almost impossible to predict exactly all the detail points you will want to know about. Hence, we often include a discussion on general design details and principles (see Project 461, Balanced Input Differential Preamp, in the December '82 issue, for example).

We would welcome other readers' views on this subject. Do you want even more design detail included in projects (remember, there's a practical limit on space)? Do you want less?

Roger Harrison
Editor, ETI.

Dear Sir,

I have just completed the ETI-5000 pre and power amps which I purchased as kits from Jaycar. The result is an amplifier that performs better than anything I have listened to. It took me six weeks of discussing and listening to amplifiers and reading about them before I made up my mind and invested $600. It certainly suits the classical/folk music I listen to.

Although I have very little electronic experience I built these amps entirely from the information in your articles. I am still trying to grasp the logic and theory of the 'workings' of these amplifiers. I appreciated your articles as they are helping me to understand things more and I can share this knowledge with my 13 year old son.

Thank you ETI, for this project which enables people with limited budgets and expensive tastes to satisfy their needs.

I would appreciate some advice on whether it is possible to fit a headphone socket direct to the speaker outputs.

Thanks again for a superb project.

W. Rath
Kambah ACT.

Headphones can be driven directly from the speaker terminals of the Series 5000 amplifier. It would be a wise idea, if doing so, to connect a series resistor between each output terminal and each headphone (right and left). The value would depend on the impedance of the 'phones. For low impedance types 330R/1 W resistors are recommended. If you wish, medium to high impedance headphones may be driven directly from the output of the preamp.

Roger Harrison
Editor, ETI

Dear Sir,

After reading about the problem of people pirating audio, video and computer software, I have come to the conclusion that one way to stop it, or at least stem the flow, is to reduce the cost of the original material to bring it more in line with the cost of the blank medium.

Let's say, for example, that the cost of a video movie is $70. If I can buy a blank tape for less than $20 and borrow another video recorder, then it's well worth the effort. But if the original tape costs less, say $30, then it wouldn't be worth the trouble.

Who is he kidding, they all say. But just think how many times a movie is pirated. A calculated guess would be at least once. Therefore each person is obtaining your movie for $35, only $5 more than my suggested price. No matter how much you reduce the cost you will still get the pirates, but most people would rather have an original in the box with the associated printed material.

This includes video, audio and computer software. So how about the marketing people having a go at selling material at a price we can all afford. Not everybody can pay $70, in these times, for movies, music or software.

The above prices are quoted as examples only.

Gary Osborn
Blackburn Sth, Vic.

Dear Sir,

I received my first prize from ETI/Minitools contest and I am very impressed with the performance and quality of these miniature tools.

I am writing to express my sincerest thanks to all those who made the contest possible. It really is a fantastic prize and I am thrilled to own such high performance gear.

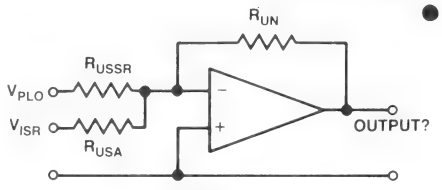
Many thanks to all at ETI and Minitools Australia.

Peter Mann
Robinvale Vic.

Dear Sir,

Many people seem to think that those of us who are interested in electronics live in a world of our own, separated from the real world and divorced from what's happening in it. I disagree, as would most of us, but I will admit that we often view it from a different perspective as this 'circuit' drawn by a friend of mine shows.

John Windle
Penrith NSW



Rod Irving's

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ICL7663	4.90	74S169	11.50	74H20	.80	74C163	2.00	74LS21	.30	74LS163	.90	74LS375	.85	6800	8.00	LM309K	1.90	741	.50
ICL7664	4.90	74S174	4.50	74H21	.90	74C164	1.90	74LS22	.30	74LS164	1.40	74LS377	2.15	6802	10.00	LM310N	3.20	UA747	1.30
ICM7211	12.50	74S175	4.50	74H22	.80	74C165	1.90	74LS24	.55	74LS165	.60	74LS378	1.20	6808	12.50	LM310H	3.20	UA748	.80
ICM7261A	47.50	74S181	8.50	74H30	.90	74C173	1.50	74LS26	.30	74LS166	2.55	74LS379	1.90	6809	17.00	LM311	.80	MC1310	9.50
ICM7216B	42.50	74S182	3.40	74H40	.90	74C174	1.50	74LS27	.35	74LS170	2.45	74LS386	.50	6810	3.50	LM311H	1.80	MC1312	6.90
ICM7217A	18.50	74S188AN	4.10	74H50	.90	74C175	1.50	74LS28	.35	74LS173	.90	74LS390	1.80	6820	5.50	LM317T	2.50	MC1314	6.90
ICM7218A	18.50	74S189	8.50	74H51	.90	74C192	1.90	74LS30	.30	74LS174	.80	74LS393	1.80	6821	3.50	LM317K	4.50	MC1315	7.50
ICM7224A	18.50	74S194	3.30	74H52	.90	74C193	1.90	74LS32	.30	74LS175	.80	74LS395	2.00	6840	6.50	LM318	3.50	MC1327	6.50
ICM7226A	48.50	74S195	2.90	74H53	.90	74C195	1.90	74LS33	.35	74LS181	2.80	74LS396	2.50	6844	15.00	LM319	3.50	MC1350	1.30
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ICM7231A	15.50	74S197/82591	4.90	74H55	.90	74C221	2.40	74LS38	.40	74LS190	1.20	74LS399	1.90	6847	7.50	LM325	4.50	MC1437	3.50
ICM7240	7.50	74S201	9.90	74H60	.90	74C240	2.60	74LS40	.40	74LS191	.80	74LS424	5.50	6850	3.50	LM326	4.50	MC1445	3.75
ICM7242	3.90	74S214AN	P.O.A.	74H61	.90	74C244	2.60	74LS42	.80	74LS192	.80	74LS440	5.50	6860	10.00	LM329DZ	.90	MC1456	1.50
ICM7250	7.90	74S225	10.90	74H62	.90	74C373	3.00	74LS47	1.80	74LS193	.80	74LS441	5.50	6875	13.50	LM344Z	1.70	MC1458	1.20
ICM7260	7.90	74S226	7.90	74H64	.90	74C374	3.00	74LS48	1.80	74LS194	.80	74LS442	5.50	Z80CPU	7.00	LM335Z	2.20	MC1466L	14.50
ICM7555	1.90	74S240	6.90	74H65	.90	74C901	1.50	74LS49	1.80	74LS195	1.25	74LS443	5.50	Z80ACPU	8.00	LM339	.90	MC1469R	6.90
ICM7556	2.50	74S241	6.90	74H71	1.40	74C902	1.00	74LS51	.35	74LS196	1.25	74LS445	2.20	Z80BCPU	16.00	LM348	1.60	MC1488	1.20
		74S244	9.90	74H72	1.20	74C903	1.00	74LS54	.40	74LS197	1.20	74LS446	5.50	Z80P10	4.50	LM349	1.60	MC1489	1.20
74S		74S251	3.90	74H73	1.80	74C904	1.00	74LS55	.40	74LS221	1.20	74LS447	1.90	Z80AP10	6.50	LM350	6.50	MC1494	7.50
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74S02	.80	74S257	3.30	74H76	1.90	74C906	1.00	74LS73	.50	74LS241	1.20	74LS449	5.50	Z80ACTC	8.50	LF356N	1.40	MC1496	1.90
74S03	.80	74S258	3.30	74H78	1.90	74C907	1.00	74LS74	.40	74LS242	1.50	74LS490	3.20	Z80DMA	16.00	LF357	1.40	LM1596	2.30
74S04	.85	74S260	2.90	74H87	7.90	74C908	1.70	74LS75	.50	74LS243	1.50	74LS540	11.95	Z80ADMA	19.00	LM358	1.00	MC1648	4.90
74S05	1.10	74S274	P.O.A.	74H101	1.80	74C910	14.00	74LS76	.55	74LS244	1.20	74LS541	11.95	Z80AS10	19.00	LM361	3.50	LM1812	10.50
74S08	.80	74S275	P.O.A.	74H102	1.80	74C911	12.50	74LS77	.65	74LS245	1.50	74LS621	2.75	Z80S10	16.00	LM377	4.90	LM1830	3.90
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74S10	.80	74S281	P.O.A.	74H106	2.50	74C914	2.50	74LS83	1.00	74LS248	1.40	74LS623	2.75	AY-3-2513	14.50	LM379-S	7.95	LM2917 8 pin	3.40
74S11	.80	74S283	7.90	74H108	2.50	74C915	2.00	74LS85	1.30	74LS249	1.30	74LS629	2.95	MM5303	7.50	LM380 8 pin	1.40	LM2917 14 pin	3.40
74S15	1.30	74S287	3.30	74H113	1.10	74C917	12.50	74LS86	.40	74LS251	1.00	74LS640	2.95	S1883	8.50	LM380 14 pin	1.50	MN3001	17.50
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74S32	.80	74S314	P.O.A.	**74C**		74C922	6.50	74LS93	.60	74LS259	2.25	74LS644	2.75	LH0070	7.50	LM384	2.75	CA3059	5.95
74S37	1.70	74S330	P.O.A.	74C00	.60	74C923	6.50	74LS95	.75	74LS261	2.50	74LS645	2.75	LH0071	7.50	LM386	1.95	CA3080	1.50
74S38	1.70	74S331	P.O.A.	74C02	.60	74C925	7.90	74LS96	1.00	74LS266	.70	74LS668	1.75	TL061	1.00	LM387	2.00	CA3086	1.80
74S40	1.20	74S373	9.90	74C04	.60	74C926	7.90	74LS107	.60	74LS273	1.55	74LS669	1.75	TL062	2.90	LM390	2.95	CA3089	3.90
74S51	.80	74S374	9.90	74C08	.60	74C927	7.90	74LS109	.60	74LS275	6.80	74LS670	2.75	TL064	2.90	LM391	2.90	CA3130E	1.60
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74S109	2.50	74S470	9.90	74C32	.60	74C941	2.50	74LS123	.90	74LS293	1.10	74LS692	3.95	TL081	1.90	LF398	5.90	LM3900	1.20
74S112	1.30	74S471	9.90	74C42	1.60	74C989	8.90	74LS125	.60	74LS295	1.50	74LS693	3.95	TL082	1.80	NE544	6.50	LM3905	1.75
74S113	1.30	74S472	P.O.A.	74C48	2.50			74LS126	.65	74LS297	16.50	74LS696	3.95	TL083	2.90	NE555	.50	LM3909	1.30
74S114	2.50	74S473	P.O.A.	74C73	1.20	**74LS**		74LS132	.80	74LS298	1.20	74LS699	3.95	TL084	2.90	NE556	1.20	LM3911	1.95
74S124	5.90	74S474	P.O.A.	74C74	1.20	74LS00	.25	74LS136	.60	74LS299	3.90			TL494	4.90	NE558	4.90	LM3914	4.90
74S132	3.50	74S475	P.O.A.	74C76	1.20	74LS01	.30	74LS138	.70	74LS320	3.95	**CPU**		TCA220	2.20	NE560	4.60	LM3915	4.90
74S133	1.20	74S482	11.90	74C83	2.30	74LS02	.25	74LS139	.70	74LS321	3.95	6502	11.00	TCA280	4.50	NE561	4.60	LM3916	4.90
74S134	1.40	74S289	7.90	74C85	2.30	74LS03	.30	74LS145	2.10	74LS322	6.75	6502A	12.00	TDA1024	2.90	NE565	1.60	LM3999Z	2.60
74S135	2.30			74C86	1.20	74LS04	.30	74LS147	2.50	74LS323	6.50	6503	11.00	TA7205P	3.90	NE566	2.90	RL4136	1.50
74S138	3.30	**74H**		74C89	6.90	74LS05	.35	74LS148	1.20	74LS324	2.20	6504	11.00	TEA1002	17.50	NE567	2.00	RC4145	2090
74S139	3.30	74H00	.80	74C90	1.60	74LS08	.30	74LS151	.90	74LS326	2.20	6505	11.00	UAA170	3.75	NE570	5.90	RC4194	3.90
74S140	1.90	74H01	.80	74C93	1.50	74LS09	.30	74LS152	1.95	74LS327	2.20	6507	11.00	UAA180	3.75	NE571	5.90		
74S151	3.10	74H02	.80	74C95	1.80	74LS10	.30	74LS153	.70	74LS352	2.20	6520	5.50	LM10CH	7.50	NE594	9.50	**SCR & TMACS**	
74S153	2.90	74H03	.80	74C107	2.20	74LS11	.30	74LS154	1.75	74LS353	2.20	6521	5.90	LM301	.50	LM709-14	1.00	SC141D	1.50

SC141E	1.95	BF458	1.00	TIP122	3.45	2N5656	2.50	74109	.60	9305	2.40	8379	8.50	**OPTO**		OM350	9.50	4096	2.40
SC142D	2.95	BF459	1.00	TIP125	2.90	2N5770	.30	74110	.80	9307	3.80	8282	6.90	4N25	1.20	IM65X08CPE	5.00	4097	6.50
SC146D	2.85	BF469	.90	TIP127	3.40	2N5777	1.50	74111	.80	9308	2.60	8283	6.50	4N26	1.20	XR2206	6.50	4098	2.90
SC146M	2.95	BF470	.90	TIP145	3.40	2N5830	.30	74112	.80	9309	2.40	8284	8.50	4N27	1.20	XR2207	6.50	4099	3.90
SC150D	4.95	BF494	.90	TIP2955	1.90	2N5831	.30	74113	.80	9310	1.50	8286	6.50	4N28	1.20	XR2208	4.90	4104	6.90
SC151D	2.95	BF495	.90	TIP3055	1.90	2N5873	1.40	74114	.80	9311	2.50	8287	6.50	4N29	1.50	XR2209	5.90	4160	1.25
C103YY	.90	BFW10	1.50	2N301	4.00	2N5874	1.70	74120	1.65	9312	2.50	8288	25.00	4N30	1.60	XR2211	6.90	4161	1.25
C103B	.90	BFW11	1.50	2N697	1.00	2N5944	15.50	74121	.65	9313	6.00	8289	73.00	4N32	2.50	XR2216	4.90	4162	1.25
C106B	.90	BFW16	1.50	2N918	1.00	2N5945	18.50	74122	.65	9314	2.40	8291	43.00	4N33	2.50	XR2240	4.90	4163	1.25
C106D	.90	BFY50	1.20	2N1304	1.00	2N5946	19.50	74123	.60	9316	1.90	8292	34.50	4N35	2.50	XR2242	4.90	4174	1.25
C122D	2.50	BFX90	1.50	2N1613	1.20	2N5961	1.90	74125	.55	9317	4.20	8293-10	26.50	4N37	2.00	XR2243	5.90	4175	1.60
C122E	2.95	BU126	2.50	2N2102	1.90	2N6027	1.00	74126	.60	9318	4.60	8741	57.50	MCT6	2.50	XR8038	6.50	4194	1.95
SC260D	8.50	BU208	3.90	2N2219	.90	2N6049	1.90	74128	1.80	9319	2.00	8748	23.50	MCT66	6.90	ICC7660	12.50	4402	1.00
SC260F	9.90	BU326	3.00	2N2222A	1.00	2N6080	8.50	74132	.80	9320	6.90	8749	58.50	MCT2	1.50	95H90	8.50	4404	1.15
2N2646	1.20	BUX80	4.90	2N2369	1.00	2N6083	17.90	74136	.55	9321	2.40	8755	33.50	1LD74	5.90	11C90	16.50	4408	6.90
2N2647	2.50	MFE131	2.90	2N2484	1.00	2N6084	22.50	74138	1.80	9322	1.90	2911	26.50	1LQ74	6.50	LM7555	1.90	4409	13.50
2N6027	.90	MFE3001	9.90	2N2646	1.20	2N6124	1.90	74139	1.00	9324	1.40	2912	27.50	FND357	1.80	MC10116L	1.50	4410	11.50
		MFE3003	6.95	2N2647	2.50	2N6125	1.90	74141	1.10	9328	4.90	2920	239.00	FND500	1.80	LF13741	.80	4411	12.60
TRANSISTORS		MJ413	5.90	2N2894	1.00	2N6130	1.90	74142	1.45	9334	6.00	3205/8205	9.90	FND507	1.80	LF13741-H	1.50	4412	.45
AC125	1.20	MJ802	7.50	2N2904	1.10	2N6133	1.90	74143	1.45	9338	5.90	3242	17.50	FND800	3.50	DS75451	.60	4415	10.15
AC126	1.20	MJ901	4.50	2N2905	1.10	2N6256	13.50	74144	3.90	9340	9.90	3245	10.90	T1L31A	2.95	DS75452	.60	4416	.60
AC127	1.20	MJ1001	3.90	2N2906	1.10	2N6259	13.50	74145	1.45	9342	5.90	3628	18.50	T1L81C	2.95	DS75491	2.00	4419	3.45
AC128	1.20	MJ11011	9.90	2N2907	1.10	2N6274	29.50	74147	1.95	9368	2.20	8008-1	62.50	T1L306	14.50	DS75492	2.00	4422	9.50
AC187	1.50	MJ11015	14.50	2N3019	1.90	2N6378	4.90	74148	1.40	9374	3.30	8031-3	29.50	BPW50	2.25	7216A	41.50	4426	2.35
AC188	1.50	MJ11016	14.50	2N3053	.90	2N6425	4.50	74150	1.15	9386	2.40	8035	6.90	CQY89	1.50	7216B	42.50	4428	1.75
AC149	3.40	MJ15003	6.50	2N3054	1.90	2N6578	5.90	74151	.60	75107	2.50	8039	7.90	MOC3011	2.95	DM2502	10.00	4433	2.25
AC161	2.90	MJ15004	6.50	2N3055	1.20	3N201	1.50	74153	.65	75110	2.50	FD1771	19.00	MOC3020	2.50	ADC0800	16.00	MC14433	13.90
AC162	2.90	MJ15024	10.00	2N3096	1.20	2SJ49	7.50	74154	1.15	75154	2.50	FD1791	35.00	MOC3021	2.95	ADC0808	17.00	4435	7.95
AF118	2.90	MJ2955	1.50	2N3109	1.90	2SK134	7.50	74155	.85	75450	1.50	FD1793	35.00			DAC0800	4.50	4441	1.50
AF126	2.90	MJ3001	6.90	2N3251	1.90	7400	.25	74156	1.45	75451	.60	FD1795	35.00	**LEDS**		DAC0808	3.50	4443	3.90
AF127	1.50	MJ4032	12.50	2N3302	1.90	7401	.30	74157	.60	75452	.60	FD1797	35.00	3mm RED	.25	SAK140	9.50	4445	2.65
BC107	.50	MJ4035	11.90	2N3440	1.80	7402	.25	74158	.85	75453	.60	WD1691	16.50	3mm YELLOW	.30	ZN414	1.95	4446	3.55
BC108	.50	MJ4502	6.90	2N3441	2.90	7403	.35	74160	.85	75461	1.50	WD2143	12.50	3mm GREEN	.15	4000	.40	4449	1.00
BC109	.50	MJE340	2.00	2N3442	3.50	7404	.30	74161	1.00	75462	1.50	WD1931	22.50	5mm RED	.15	4001	.40	4450	3.75
BC159	.50	MJE350	2.50	2N3563	.30	7405	.35	74162	1.00	75471	3.00	WD1933	34.00	5mm GREEN	.30	4002	.40	4451	3.75
BC177	.60	MJE371	2.90	2N3564	.30	7406	.40	74163	1.00	75472	3.00	WD1983	14.75	5mm YELLOW	.30	4006	1.60	4457	5.90
BC178	.60	MJE521	2.50	2N3565	.30	7407	.40	74164	.60	75491	2.00	WD1993	59.00	5mm ORANGE	.30	4007	.50	4458	9.90
BC179	.60	MJE700	3.50	2N3566	.30	7408	.35	74165	.60	75492	2.00	WD2123	26.50	RED RECT	.30	4008	1.40	4469	14.90
BC212	.30	MJE800	2.90	2N3567	.30	7409	.35	74166	1.35	75493	3.00	WD8250	16.50	GREEN RECT	.30	4009	.60	4490	5.90
BC318	.30	MJE2801	3.95	2N3568	.30	7410	.30	74167	2.20	75494	3.00	TR1602	8.50	YELLOW RECT	.30	4010	.70	4495	3.95
BC320	.40	MJE2955	4.90	2N3569	.30	7411	.35	74174	1.45	8121	4.00	TR1863	8.90	RED CHROME		4011	.40	4500	8.90
BC327	.30	MJE3055	3.90	2N3638	.30	7412	.35	74175	.85	8123	4.00	COM8116	24.00	BEZEL	1.20	4012	.50	4501	.50
BC328	.30	MJE13005	5.90	2N3640	.30	7413	.50	74176	1.10	8130	6.00	BR1941	12.50	YELLOW CHROME		4013	.75	4502	1.80
BC338	.30	MJE13007	7.90	2N3641	.30	7414	.70	74177	1.10	8131	3.95			BEZEL	1.20	4014	1.50	4503	.90
BC546	.40	MJE13009	12.50	2N3642	.30	7415	.35	74178	2.15	8135		**74F SERIES**		GREEN CHROME		4015	.95	4504	2.00
BC547	.20	MPF121	2.50	2N3643	.30	7416	.60	74179	2.15	8136	4.25	74F00	.79	BEZEL	1.20	4016	.65	4506	.75
BC548	.20	MPF131	2.50	2N3644	.30	7417	.55	74180	.90	8303	5.50	74F02	.79			4017	1.20	4507	.40
BC549	.20	MPSA05	1.00	2N3645	.30	7420	.25	74182	.90	8304	5.50	74F04	.92	**VOLTAGE REGS**		4018	1.50	4508	4.50
BC550	.40	MPSA06	1.00	2N3646	.30	7421	.40	74184	1.20	82S23	4.50	74F08	.79	7805UC	.90	4019	.60	4510	1.50
BC556	.40	MPSA09	1.00	2N3702	1.20	7422	.40	74190	1.00	82S123	3.90	74F10	.79	7805KC	2.00	4020	1.35	4511	1.50
BC557	.20	MPSA10	1.00	2N3704	1.40	7423	.45	74191	1.45	8311	4.87	74F11	.79	7812UC	.90	4021	1.10	4512	1.10
BC558	.20	MPSA12	1.00	2N3739	4.50	7425	.45	74192	1.65	8641	3.83	74F20	.79	7812KC	2.00	4022	1.15	4513	2.65
BC559	.20	MPSA13	1.00	2N3771	5.50	7426	.35	74193	.80	8820	4.95	74F32	.79	7815UC	.90	4023	.40	4514	2.90
BC635	.80	MPSA14	1.00	2N3772	5.70	7427	.40	74194	1.10	8830	5.00	74F64	.79	7815KC	2.20	4024	1.00	4515	2.90
BC636	.80	MPSA20	1.00	2N3773	5.90	7428	.40	74195	.65	8831	5.00	74F74	.89	7818UC	1.00	4025	.40	4516	1.45
BC637	.80	MPSA42	1.00	2N3792	6.00	7430	.35	74196	.85	8832	5.00	74F86	1.19	7818KC	2.20	4026	2.00	4517	8.75
BC638	.80	MPSA43	1.20	2N3819	1.20	7432	.35	74197	1.10	8833	4.90	74F109	.99	7824UC	1.00	4027	.60	4518	1.50
BC639	.50	MPSA55	1.00	2N3866	2.95	7433	.55	74198	1.10	8834	5.90	74F138	1.79	7824KC	2.40	4028	.90	4519	.90
BC640	.50	MPSA56	1.00	2N3904	1.00	7437	.40	74199	1.30	8835	4.00	74F139	1.79	7905UC	1.40	4029	1.20	4520	1.55
BCY70	1.90	MPSA63	1.00	2N3906	1.00	7438	.45	74221	.90	8836	2.00	74F151	1.79	7905KC	3.00	4030	.60	4521	3.90
BCY71	1.90	MPSA65	1.00	2N4032	2.20	7439	.70	74240	1.50	1488	1.20	74F153	1.79	7912UC	1.40	4031	2.50	4522	1.90
BD135	1.00	MPSA92	1.00	2N4033	2.20	7440	.45	74241	1.50	1489	1.20	74F157	1.79	7912KC	3.00	4032	2.25	4526	1.85
BD136	.90	MPSA93	1.20	2N4036	2.50	7442	.50	74242	1.50	81LS95	2.20	74F158	1.79	7915UC	1.50	4033	2.25	4527	2.65
BD137	.90	MPF102	.90	2N4121	1.50	7443	1.30	74243	1.50	81LS96	2.20	74F175	2.78	7915KC	3.00	4034	3.00	4528	1.15
BD138	.90	MPF103	.90	2N4123	1.50	7444	1.10	74244	1.75	81LS97	2.20	74F181	5.98	7918UC	1.50	4035	1.30	4529	1.80
BD139	.60	MPF105	.90	2N4236	1.90	7445	1.10	74245	1.75	81LS98	2.20	74F182	2.73	7924UC	1.50	4038	2.75	4530	1.60
BD140	.90	MPF106	.90	2N4237	1.90	7446	1.00	74246	2.25	8T26	3.00	74F189	7.44	78L05	.50	4040	1.40	4531	1.65
BD201	.90	MPF109	.90	2N4248	.40	7447	.95	74247	2.25	8T28	3.00	74F190	4.86	78L12	.50	4041	1.50	4532	2.65
BD202	.90	MPSL01	1.50	2N4249	.40	7448	1.00	74248	2.25	8T30	3.00	74F191	4.86	78L15	.60	4042	.70	4534	8.90
BD232	.90	MPSL51	1.50	2N4250	.40	7449	1.00	74249	2.25	8T96	1.80	74F194	2.41	78L18	.60	4043	.80	4536	6.50
BD233	.90	MPSU02	1.75	2N4258	.50	7450	.45	74251	1.10	8T97	1.80	74F241	3.72	78L24	.60	4044	.75	4538	2.75
BD235	.90	MPSU52	1.90	2N4355	.50	7451	.45	74253	1.10	8T13	2.95	74F243	4.34	79L05	1.00	4045	4.90	4539	1.65
BD236	.90	MPSU56	1.75	2N4356	.50	7452	.40	74257	1.50	8T14	2.95	74F244	3.72	79L12	1.00	4046	1.25	4541	1.60
BD237	.90	MPU131	1.50	2N4360	1.00	7453	.35	74258	1.50	8080	8.00	74F251	1.93	79L15	1.00	4047	1.50	4543	2.50
BD238	.90	MRF221	19.50	2N4401	.30	7454	.40	74259	2.45	8085	8.50	74F253	1.93	79L18	1.00	4048	1.00	4544	10.50
BD262	1.20	MRF237	3.90	2N4402	.30	7455	.45	74273	2.45	8086	59.00	74F257	1.93	79L24	1.00	4049	.60	4549	7.25
BD263	1.20	MRF238	17.50	2N4403	.30	7460	.35	74276	2.45	8088	25.00	74F258	1.93	LM309K	1.90	4050	.60	4551	1.80
BD437	1.50	MRF245	38.50	2N4416	1.90	7461	.45	74278	3.45	8155	6.50	74F350	4.34	LM317T	2.50	4051	1.20	4553	5.50
BD488	1.50	MRF421	39.00	2N4427	2.90	7462	.55	74279	.85	8156	6.50	74F352	1.93	LM317K	4.50	4052	1.20	4554	2.35
BD647	1.80	MRF454	29.00	2N4919	2.90	7463	.85	74283	2.45	8185	37.50	74F353	1.93	LM323K	6.50	4053	1.20	4555	1.10
BD648	1.80	MRF455	24.00	2N5088	1.00	7470	.45	74289	3.25	8202	52.50	74F373	4.84	LM337T	2.90	4054	3.90	4556	1.25
BD677	1.80	MRF455A	24.00	2N5089	1.00	7472	.45	74290	.90	8203	58.50	74F374	4.84	LM337	6.50	4055	3.90	4557	7.85
BD681	1.50	MRF475	4.20	2N5139	1.20	7473	.50	74293	.90	8206	115.50	74F399	2.78	LM338K	9.50	4056	4.20	4558	2.25
BD682	1.50	MRF641	29.00	2N5179	1.20	7474	.35	74295	1.65	8212	3.00	74F521	4.22	LM350T	6.50	4060	1.85	4559	7.25
BDV64B	5.50	MRF646	39.00	2N5190	2.50	7475	.55	74298	2.45	8214	4.90	74F533	4.84	LM350K	7.50	4063	2.00	4560	3.75
BDV65B	5.50	RF901	2.75	2N5191	3.30	7476	.40	74299	1.75	8216	3.00	74F534	4.84	LM395K		4066	.80	4561	1.80
BDX63	6.50	MPF131	1.30	2N5192	3.10	7477	.60	74351	1.85	8224	3.50			LM396K	19.50	4067	9.90	4562	8.45
BDY96 (BUX)	80)	TIP31A	.90	2N5193	2.50	7478	.60	74352	1.85	8226	4.90	**MEMORY**		78H05KC	9.00	4068	.50	4566	3.00
	4.90	TIP31B	1.00	2N5194	2.95	7480	.70	74365	.80	8228	5.50	2101	6.90	78H12KC	9.00	4069	.60	4568	4.25
BDY97 (BUX)	80)	TIP31C	1.20	2N5195	3.30	7481	1.90	74366	.80	8231	199.00	2102	2.50	78HGKC	9.50	4070	.45	4569	2.50
	4.90	TIP32A	.90	2N5210	1.50	7482	1.80	74367	1.20	8232	199.00	2112	7.90	78P05KC	14.50	4071	.40	4572	.75
BF115	1.50	TIP32B	1.00	2N5245		7483	.80	74368	1.20	8237	39.00	2114	1.95	79HGKC	16.50	4072	.45	4580	8.95
BF167	1.20	TIP32C	1.20	2N5303	6.50	7485	.80	74373	2.25	8238	9.50	3147	6.90	78S40	3.50	4073	.55	4581	3.10
BF173	1.20	TIP41A	1.90	2N5401		7486	.40	74374	2.25	8243	8.50	2708	5.90	MC1496L	14.50	4075	.55	4582	2.25
BF177	1.20	TIP41C	2.00	2N5457	1.00	7489	3.90	74375	.75	8251	4.90	2716	4.90			4076	1.20	4583	1.65
BF180	1.20	TIP42A	1.90	2N5458	.90	7490	.50	74377	2.45	8253	7.50	2732	7.00	**SPECIAL**		4077	.50	4584	.85
BF182	.90	TIP42C	2.00	2N5459	.90	7491	.55	74390	1.95	8255	5.50	2764	15.00	FUNCTION		4078	.60	4585	2.10
BF183	.60	TIP49	1.90	2N5461	.90	7492	.60	74393	1.95	8257	16.50	4116	1.95	LM4250	2.45	4081	.40	4597	
BF184	.60	TIP50	2.20	2N5462	.90	7493	.50	74425	2.55	8259	6.50	4164	9.00	NE5534N	1.95	4082	.40	4599	3.45
BF198	.60	TIP53	2.50	2N5485	.90	7494	.85	74426	2.55	8271	89.00	6116	10.00	NE5534AN	2.50	4085	2.20	45104	7.25
BF199	.60	TIP111	2.50	2N5486	.90	7495	.45	74490	2.65	8272	33.00	58725	9.00	MC3340	1.90	4086	2.30	45106	7.85
BF200	1.20	TIP112	2.50	2N5489	14.50	7496	.80	9300	1.50	8273	65.00	5101	7.90	MC3341	2.90	4089	3.50	45107	7.25
BF245	1.50	TIP116	2.50	2N5590	16.50	7497	2.30	9301	2.50	8274	42.50	8101	7.90	76477	5.95	4093	.75	4109	7.25
BF337	1.50	TIP117	2.50	2N5591	18.50	74100	1.65	9302	2.90	8275	38.50	2532	12.50	76488	5.95	4094	3.35	45112	7.85
BF338	1.90	TIP120	2.90	2N5641	19.50	74107	.75	9304	4.00	8276	28.50			8038	6.50	4095	2.40		

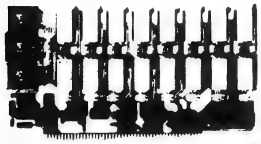
64K SS50 STATIC NOW AVAILABLE $399 + TAX
64K S100 STATIC NOW AVAILABLE $399 + TAX
DON'T FORGET TO CHECK WITH US BEFORE YOU BUY A COMPUTER OR OTHER PRODUCTS

ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070, MELBOURNE, VICTORIA

S100 COMPUTER PRODUCTS

16K EPROM CARD-S 100 BUSS



$109.00

BLANK PC BOARD $69.00
USES 2708's!

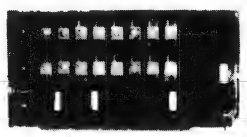
Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708'S ARE $5.90EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD $36

32K S-100 EPROM CARD

NEW!



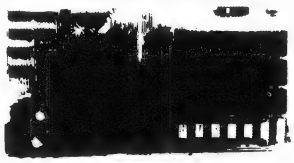
$109.00

KIT
USES 2716's
Blank PC Board – $69
ASSEMBLED & TESTED ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $5.90 EA. With Above Kit.

KIT FEATURES
1. Uses +5V only 2716 (2Kx8) EPROM's
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible
4. Addressable as two independent 16K blocks
5. Cromemco extended or Northstar bank select
6. On board wait state circuitry if needed
7. Any or all EPROM locations can be disabled
8. Double sided PC board: solder-masked, silk-screened
9. Gold plated contact fingers
10. Unselected EPROM's automatically powered down for low power
11. Fully buffered and bypassed
12. Easy and quick to assemble

* * * AVAILABLE AGAIN * * *



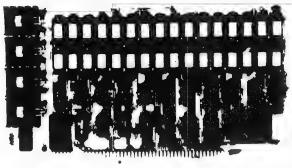
- 16K Dynamic Ram Board
- Fully Expandable to 64K
- Assembled, tested and guaranteed
- S100 Compatible

16K Dynamic RAM Board assembled and tested: Special $269 plus tax (4mHz) $299 plus tax (4mHz) This must be the best offer available on quality tested dynamic RAM boards.

32K Assembled and tested $289 plus tax (4mHz)
48K Assembled and tested $309 plus tax (4mHz)
64K Assembled and tested $329 plus tax (4mHz)

16K STATIC RAM KIT-S 100 BUSS

KIT $179
A&T $199



KIT FEATURES
1. Addressable as four separate 4K Blocks
2. ON BOARD BANK SELECT circuitry (Cromemco Standard) Allows up to 512K on line
3. Uses 2114 (450NS) 4K Static Rams
4. ON BOARD SELECTABLE WAIT STATES
5. Double sided PC Board with solder mask and silk screened layout. Gold plated contact fingers
6. All address and data lines fully buffered
7. Kit includes ALL parts and sockets
8. PHANTOM is jumpered to PIN 67
9. LOW POWER under 1.5 amps TYPICAL from the +8 Volt Buss
10. Blank PC Board can be populated as any multiple of 4K

BLANK PC BOARD W DATA $69.00
LOW PROFILE SOCKET SET $22
SUPPORT IC'S & CAPS $29
ASSEMBLED & TESTED ADD $30

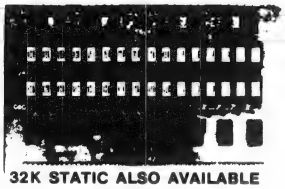
OUR #1 SELLING RAM BOARD!

16K STATIC RAM SS-50 BUSS

PRICE CUT!

$199 KIT
A&T $219

FULLY STATIC AT DYNAMIC PRICES



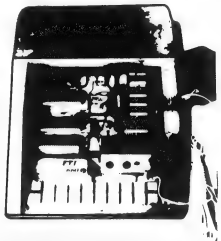
FOR SWTPC 6800 BUSS!

KIT FEATURES
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board Solder mask and silk screened layout Gold fingers
5. All Parts and Sockets included
6. Low Power Under 1.5 Amps Typical

32K STATIC ALSO AVAILABLE

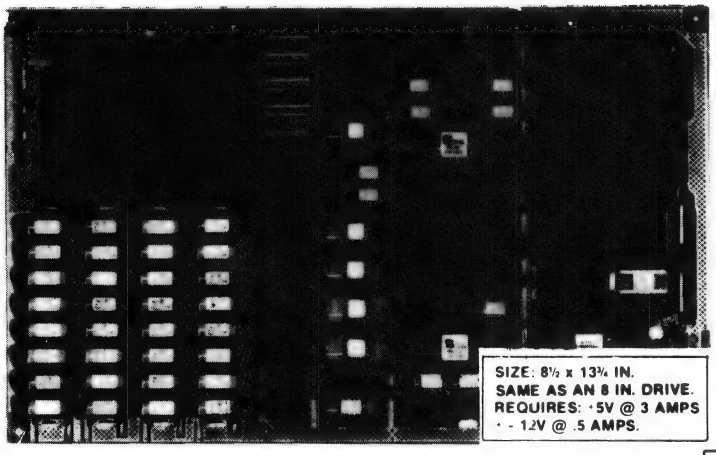
BLANK PC BOARD – $69 COMPLETE SOCKET SET – $22 SUPPORT IC'S AND CAPS – **$49**

ETI 660 THE $99 COMPUTER!



FEATURES INCLUDE
Colour capability, operates from optional 9 V plugpack, 1K memory expandable to 3K on-board, single-board construction, cassette interface, audio output, simple to program (uses Chip-8)
Expansion projects coming up include ASCII keyboard, light pen, games software, etc
Starter Kit (1K RAM, B&W Video) $99.00
9 V, 1 amp plug pack to suit $12.50
Colour video option $13.50
RAM Expansion (add to PCB) $16.00

ETI636 7 SLOT MOTHERBOARD WITH ACTIVE TERMINATION
Kit of Parts $89.00. Assembled and tested $115.00, inc tax.
RITRON COMPUTER GRADE POWER SUPPLY: +5V Reg. 10A, ± 16V Unreg. Kit of parts $89.90 inc tax A&T $109.00 inc tax
Write for list of other power supplies. Tax free prices also available.



SIZE: 8½ x 13¾ IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ 3 AMPS
+ - 12V @ .5 AMPS.

SINGLE BOARD COMPUTER KIT NOW ONLY $475 Including tax ($435 tax exempt)

Also available: Blank PCB's with Roms **$275** + Tax.
Assembled & Tested $599 inc. tax.

THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, and an enclosure: and you have a total Business System for about 1/3 the cost you might expect to pay.

FEATURES: (Remember, all this on one board!)

64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user. our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: **$49**

FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

FOUR PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: **$21**

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: **$15**

PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided. It does not occupy any of the 64K of system RAM!

FERGUSON TRANSFORMERS

PRINTED CIRCUIT BOARD MOUNTING TRANSFORMERS

PL9/5VA	$7.95	PL24/5VA	$7.95	PL18/12VA	$10.50
PL12/5VA	$7.95	PL30/5VA	$7.95	PL24/12VA	$10.50
PL15/5VA	$7.95	PL40/5VA	$7.95	PL30/12VA	$10.50
PL18/5VA	$7.95	PL161/5VA	$10.50		

LOW PROFILE CHASSIS MOUNTING TRANSFORMERS

PL12/20VA	$14.75	PL12/60VA	$19.50	PL24/40VA	$16.50
PL15/20VA	$14.75	PL15/60VA	$19.50	PL30/40VA	$16.50
PL18/20VA	$14.75	PL18/60VA	$21.50	PL40/40VA	$16.50
PL24/20VA	$14.75	PL24/60VA	$21.50	PL30-9/40VA	
PL30/20VA	$14.75	PL12/40VA	$16.50		$23.50
PL40/20VA	$14.75	PL15/40VA	$16.50	PL30/60VA	$21.50
PL1.5-18/20VA		PL18/40VA	$16.50	PL30-9/60VA	
	$23.50				$25.50

CONVENTIONAL CHASSIS MOUNTING TRANSFORMERS

PF3577	$33.90	PF3993	$23.90	PF4362	$57.90
PF3783	$79.50	PF4244	$46.50	PF4363	$57.90
PF3787	$21.50	PF4354	$49.50	PF4405	$44.50
PF3788	$43.50	PF4361/1	$49.50		

BELL TRANSFORMERS

PPB4/1000 $15.50 PPB8/1000 $15.50 PPB12/500 $15.50

AUDIO TRANSFORMERS

MT552 $28.50 OP590 $46.50 OP592 $36.90

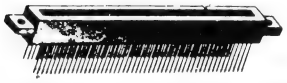
D.C. POWER SUPPLIES

PPA3DC $12.90 PPA6DC $12.90 PPA9DC $12.90
PPA4.5DC $12.90 PPA7.5DC $12.90

INTERSIL LCD $38.50 3½ DIGIT PANEL METER KITS

Build a working DPM in ½-hour with these complete evaluation kits. Test these new parts for yourself with intersil's low cost prototyping kits complete with A D converter and LCD display (for the 7106) or LED display (for the 7107). Kits provide all matrials including PC board, for a functioning panel meter ICL7106EV (LCD)

P.C. EDGE CONNECTORS



S100 gold plated wire wrap	**$8.50**
S100 solder tail	**$7.90**
D2 Motorola bus	
43 86 solder tail	**$8.50**
43 86 gold plated wire wrap	**$11.50**

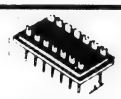
10 TURN POTENTIOMETERS

Stock resistance values

50R 100R 200R
500R 1K 2K 5K
10K 20K 50K
100k

Spectrol model 534 ¼" shaft
Price 1 9 $10.90
10 + values may be mixed $10.00

DIP PLUGS



Ideal for use with flat ribbon cable or to mount components on

14 pin $1.50 24 pin $2.90
16 pin $1.90 40 pins $5

POWER TRANSFORMERS

SPECIALLY DESIGNED FOR MICROCOMPUTERS

- Good regulation electrostatic shield
- RI 810 8V @ 10A x 15V @ 1A $31.00
- RI 820 8V @ 20A 15V @ 1A 15V @ 3A $37.50

20 TURN CERMET TRIM POT

SPECTROL 43P ACTUAL SIZE

STOCK RESISTANCE VALUES
10R 20R 50R 100R 200R 500R 1K 2K 5K 10K 20K 50K 100K 200K 500K 1M 2M

1 9 $1.80
10 99 $1.60
100 $1.30

Values may be mixed.

Hexadecimal Keypad $36.50

19 key pad includes 1-10 keys ABCDEF and 2 optional keys and a shift key

Ideal for dream project

MULTIDIALS

Dials to suit 10 T Pots

Model 21 1.8" dia $18.50
Model 16 9" dia $13.50
Model 18 1" x 1.75" dia $21.50

cermet single TURN TRIM POT

Spectrol model 63P ACTUAL SIZE

STOCK VALUES
10R 20R 50R 100R 200R 500R 1K 2K 5K 10K 20K 50K 200K 500K 1M 2M

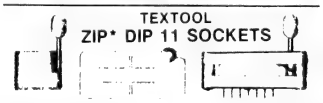
1 9 $1.20
10 99 $1.00
100 $0.90

Values may be mixed.

DIP SWITCHES SPST

P N	No of Switches	Price
SD3	3	$1.60
SD4	4	1.70
SD5	5	1.90
SD6	6	2.30
SD7	7	2.40
SD8	8	2.50
SD9	9	2.70
SD10	10	3.00

DIP SWITCHES SPST



TEXTOOL ZIP* DIP 11 SOCKETS

16 Pin Zip* Dip 11	$11.50
24 Pin Zip* Dip 11	12.50
40 Pin Zip* Dip 11	17.50

*Zero Insertion Pressure

INCREDIBLE MEMORY AND DISC DRIVE PRICES

	1-9	10-25	25+
2708	4.90	4.00	3.90
2716	4.90	4.20	3.90
2732	8.00	7.50	7.00
4116 (200nS)	1.95	1.80	1.75
4164 64K Dynamic	11.00	10.00	9.50
M58725P (2K x 8) Static (As used in new 64K Static S100 PCB)	10.00	9.00	8.50

ALL PRICES INCLUDE SALES TAX

DISK DRIVES

MPI 51 $275.00 + 17.5% ST
MPI 52 $385.00 + 17.5% ST.
MPI 91 $415.00 + 17.5% ST.
MPI 92 $515.00 + 17.5% ST.

Mitsubishi 8" $625 including tax.

Microline 80 $499 inc tax

BUILD YOUR OWN SPEAKERS WITH PHILLIPS

PART No	PRICE
AD0140T8	$11.86
AD01610T8	$16.95
AD01605-TB	$16.54
AD0162-T15	$18.78
AD0162-T15	$13.03
AD0162-TB	$13.77
AD0210-SQ8	$42.00
AD02160-SQ8	$45.00
AD02161-SQ8	$33.46
AD10100-W8	$52.72
AD12100-HP8	$85.10
AD12100-M15	$79.11
AD12100-M8	$79.11
AD12100-W8	$53.99
AD12200-W8	$73.12
AD12250-W8	$83.00
AD12650-W8	$59.00
AD2273-T8	$5.03
AD4060-W8	$19.06
AD5060-SQ4	$22.05
AD5060-SQ8	$22.05
AD5060-W8	$17.59
AD5061-MB	$17.08
AD70601-W8	$22.00
AD70620-M8	$21.54
AD7063-M8	$20.78
AD70630-M8	$20.78
AD70650-W8	$26.96
AD7066-W8	$26.96
AD80601-W8	$20.24
AD8061-W8	$20.24
AD80652-W8	$26.20
AD8066-W4	$27.66
AD8081-M8	$9.81
AD9710-M8	$41.11
ADF1600-8	$19.44
ADF500-4500-8	$19.44

DIODES

	10-99	100+
IN4001	6c	5c
IN4002	6c	5c
IN4004	7c	6c
IN4148	5c	4c
IN5404	30c	25c
IN5408	35c	30c
IN4007	12c	11c

HEATSINKS

High Thermal Capacity Black Anodised

	1-4 $	5-9 $	10-49 $	50-99 $	100-499 $	500 plus $
HS1 — 38mm	1.85	1.75	1.50	1.35	1.00	0.90
HS2 — 75mm	3.00	2.90	2.50	2.00	2.00	1.50
HS3 — 150mm	5.80	5.40	4.90	3.80	2.90	2.70
HS4 — 225mm	8.10	7.60	7.10	5.90	4.50	4.30
HS5 — 300mm	8.90	8.40	7.90	6.50	4.90	4.60

Unanodised

HS11 — 38mm	1.40	1.20	1.00	0.90	0.80	0.70
HS12 — 75mm	2.50	2.20	1.90	1.60	1.25	1.20
HS13 — 150mm	4.90	4.50	4.00	3.20	2.45	2.40

RS232 & "D" TYPE CONNECTORS

PART NO	DESCRIPTION	1 9	10 25	25+
DE 9P	9 PIN MALE	$3.50	$3.50	$3.10
DE 9S	9 PIN F MALE	4.50	4.20	3.90
DE 9C	9 PIN COVER	2.20	2.10	1.90
DA 15P	15 PIN MALE	4.50	4.20	3.90
DA 15S	15 PIN F MALE	5.10	4.90	4.70
DA 15C	15 PIN COVER	2.30	2.10	2.00
DB 25P	25 PIN MALE	5.90	5.60	5.10
DB 25S	25 PIN F MALE	6.90	6.60	6.10
DB 25C	1 pc Grey Hood	2.40	2.20	2.00
DB 25C2B	2 pc Black Hood	2.80	2.70	2.50
DB 25C2G	2 pc Grey Hood	2.70	2.50	2.40
DC 37P	37 PIN MALE	7.90	7.50	7.10
DC 37S	37 PIN F MALE	10.90	9.90	9.10
DC 37C	37 PIN COVER	4.90	4.50	4.10
DH S	Hardware set (2 Pairs)	2.10	1.90	1.80

BLANK CASSETTES T.D.K.

TDK ADC60	1 for $3.60	10 for $26.00
TDK DC60	1 for $2.10	10 for $18.00
TDK ODC60	1 for $3.50	10 for $31.00
TDK SAC60	1 for $3.50	10 for $31.00
TDK SAXC60	1 for $5.70	10 for $46.00
TDK DC90	1 for $2.40	10 for $21.00
TDK ADC 90	1 for $3.50	10 for $30.00
TDK SAC 90	1 for $4.20	10 for $39.00
TDK ODC90	1 for $4.70	10 for $45.00
TDK SAXC90	1 for $5.50	10 for $49.00
TDK DC120	1 for $4.50	10 for $37.00
TDK ADC120	1 for $5.40	10 for $46.50

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Post & Pack $2.50 small kits, heavier kits add extra postage.
Prices subject to change without notice. Send 60c and SAE for free price list and inclusion on all future mailing lists.
MAIL ORDERS: PO Box 235, Northcote, Vic 3070. Min P & P $1.00.
Ph: (03) 489 8131. ERRORS AND OMISSIONS EXCEPTED

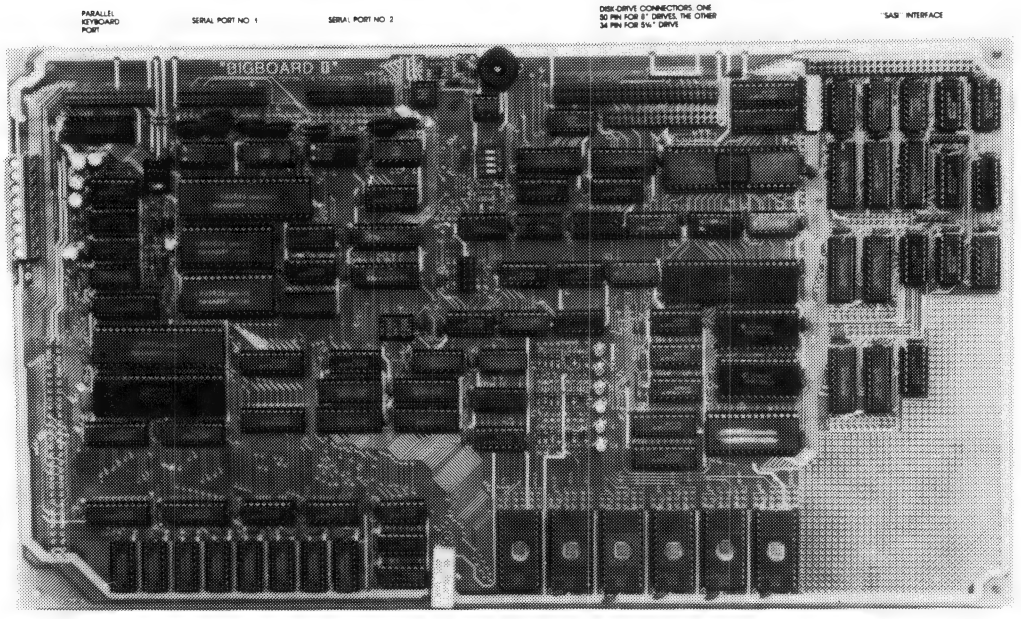
ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070, MELBOURNE, VICTORIA. Ph (03) 489 8131 Telex No. 38897
48–50 A'BECKETT STREET, MELBOURNE (03) 347-9251

RITRONICS WHOLESALE PTY LTD

425 HIGH STREET NORTHCOTE 3070 MELBOURNE (03) 489-8131
48–50 A'BECKETT STREET MELBOURNE (03) 347-9251

"BIG BOARD II"



EPROMs shown only for clarity.

STD Bus Connector

Prototyping Area

Jim Ferguson, the designer of the "Big Board" distributed by Digital Research: Computers, has produced a stunning new computer that we will begin shipping in November called "Big Board II", it has the following features:

4 MHz Z80 — CPU AND PERIPHERAL CHIPS

The Ferguson computer runs at 4 MHz. Its monitor code is lean, uses Mode 2 interrupts, and makes good use of the Z80-A DMA chip.

64K DYNAMIC RAM + 4K STATIC CRT RAM + 24K E(E)PROM OR STATIC RAM

"Big Board II" has the three memory banks. The first memory bank has eight 4164 RAMs that provide 60K of user space and 4K of monitor space. The second memory bank has two 2Kx8 SRAMs for the memory-mapped CRT display and space for six 2732 As, 2Kx8 staticRAMS, or pin-compatible E(E)PROMs. The third memory bank is for RAM or ROM added to the board via the STD bus. Whether bought as a bare board, a full kit, or assembled and tested, it comes with a 350 nS2732 EPROM containing the monitor.

MULIPLE-DENSITY CONTROLLER FOR SS/DS FLOPPY DISKS

The new Ferguson single-board computer has a multiple-density disk controller. It can use 1793, 1797, or 8877 controller chips since it generated the signal with TTL parts. The board has two connectors for disk signal with 34 pins for 5.25" drivers, the other with 50 pins 8" drives.

VASTLY IMPROVED CRT DISPLAY

The new Ferguson SBC uses a 6845 CRT controller and 8002 Video Attributed controller to produce a display that will rival the display of quality terminals. Characters are formed by a 5x7 dot matrix on 15.75 KHz monitors and 7x9 dot matrix on 18.60 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters. 8002a chip supplied for 18 to 60 KHz monitors.

STD BUS CONNECTOR

The Ferguson computer brings its bus signals to a convenient place on the PC board where users can solder an DSTD, bus cards can be plugged directly into it, and it can as well be connected by bus cable to industry-standard card cages.

DMA

The new Ferguson computer has a Z80-A DMA chip that will allow byte-wise data transfers at 500K bytes per second and bit serial transfers via the Z80-A S10 at 880K bytes per second with serial processor overhead, though the monitor for the new computer uses the DMA chip mainly for transferring data to and from disk, the chip can readily be used for other things since its "wait/ready" pin can be connected under software control to some half a dozen signal lines. When a hard-disk subsystem is connected to the "Big Board II" via its "SASI" interface, the DMA chip makes breathtaking disk performance possible.

"SASI" INTERFACE FOR WINCHESTER DISKS

The "Big Board II" implements the Host portion of the "Shugart Associates Systems Interface". Adding a Winchester disk drive is no harder than attaching a floppy-disk drive. A user simply 1: Runs a 50-conductor ribbon cable from a header on the board to any of several inexpensive controller cards for Winchester drives that implement the controller portion of the SASI interface. 2: Cables the controller to an appropriate drive, and 3: Provides power for the controller-card and drive. Since our CBIOS contains code for communication with hard-disk, that's all a user has to do to add a Winchester to a system!

A Z80-A S10/0 = TWO ASYNCHRONOUS/SYNCHRONOUS SERIAL PORTS
A PARALLEL KEYBOARD PORT = FOUR OTHER PARALLEL PORTS USER 1/0

The new Ferguson single-board computer has one parallel port for an ASCII keyboard and four others for user-defined 1/0. When the computer is powered-up or reset, the monitor looks for a carriage-return at the keyuboard and serial ports. If the first carriage-return the monitor gets comes from the parallel keyboard, the monitor uses the board's video display circuitry to communicate with the user via a CRT. If the first carriage-return is typed at an ASCII terminal attached to a serial port, the monitor autabauds and makes the terminal the system console.

TWO Z80-A CTCs = EIGHT PROGRAMMABLE COUNTERS/TIMERS

The new Ferguson computer has two Z80-A CTCs. One is used to clock data into and out of the Z80-A S10/0, while the other is for systems and application use.

PROM PROGRAMMING CIRCUITRY AND SOFTWARE

The new Ferguson SBC has circuitry and drivers for programming 2716s, 2732(A)s, or pin-compatible (E)EPROMs. Software $25 extra.

CP/M

CP/M with Russell Smith's CBIOS for the new Ferguson computer is available for $220. The CBIOS is available separately for $65.
Actual board size: 39.6cm x 22.2cm. 5 inch BIOS being developed. Approx price $95.

Pricing and Availability:

Availability: 2 weeks delivery.
In single quantities, full kits cost $750.00 + tax, and A&T'd computers cost $895. There are attractive discounts that range to 35% for OEM's and dealers. For details about them please call Rod Irving on (03) 489 7099. ie: 3 Ferguson II "Big Board" are less 20% off the one-off price, hard disks disk controllers, boxes and power supply to suit both 8" & 5¼" systems will be available.

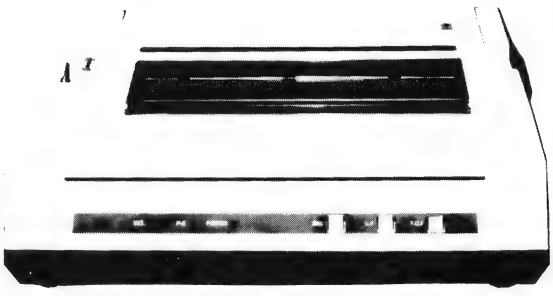
Errors and omissions excepted.

NOW OPEN AT 48–50 A'BECKETT STREET, MELBOURNE

C. Itoh PRINTERS

FROM ROD IRVING ELECTRONICS

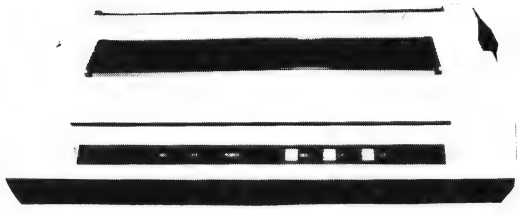
WE NOW HAVE 2 LOCATIONS IN MELBOURNE



Pro/Writer Printer 8510

Print Features: Number of columns—136 col. max. Print Speed—120 CPS. Print Direction—Single-directional and Bidirectional, Switch Selectable. Throughput Speed—From 44 to 152 lpm. Character spacing (max. number of columns per line)—Pica 10 CPI (80), Double Width 5 CPI (40), Compressed Font 17 CPI (136), Double Width 8.5 CPI (68), Elite 12 CPI (96), Double Width 6 CPI (48), Proportional Double Width Proportional. Line Spacing—Variable to 1/144". Print Width—203 mm (8") max.
Forms Type: Fan Fold Roll or Cut Sheet: Width—113 mm to 254 mm (4.5" to 10.0"). Total Thickness—0.05 to 0.28 mm (0.002" to 0.011"). Number of Copies—Original + 3 copies nominal.
Form Feed: Method—Tractor or Friction. Form Loading—Either rear or top.
Interface—Serial: Method—EIA RS232-C and 20mA (40 & 60mA switchable option) Current Loop Serial Interface. Baud Rate (BPS)—110, 300, 600, 1200, 2400, 4800, 9600. Transmitting Method—Half Duplex. Synchronization—Asynchronous.
Interface—Parallel: Method—TTL compatible, 7-bit, parallel interface. Control Signals—ACK, BUSY, SELECT, DATA STB, INPUT PRIME FAULT, INPUT BUSY, PAPER EMPTY. Instruction Codes—(ASCII): CR, LF, VT, FF, CAN, SO, SI, DEL, DC1, DC2, DC3, DC4, GS, RS, US, FS, EM; GRAPHIC SYMBOLS: BIT GRAPHICS.
Error Detection: (1) Parity (VRC)—Odd, Even, No-parity. Switch selectable. (2) Framing Error—Stop bit check. (3) Overrun Error—Error is detected when data are received before the previous data have been processed.
Physical dimensions: 398 mm W x 120 mm H x 285 mm D (15.7" W x 4.7" H x 11.2" D).
Weight: 8.5 kg (18 lbs., 12 oz.)

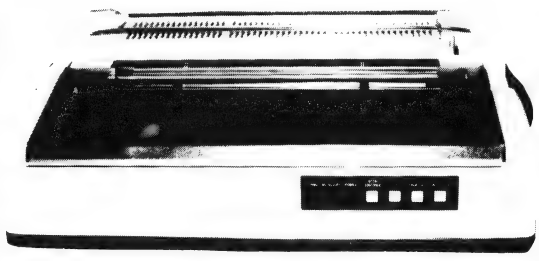
P*$855 ($755 ex)
S**$895 ($810 ex)



Model 1550

The Model 1550 is a compact desk-top dot matrix serial impact printer used for data communication terminals, hardcopy of CRT displays, peripheral terminals for minicomputers and microcomputers, and small-sized business systems.
The character format is a dot matrix of 7(H) x 9)(V). or 8(H) x 8(V).
Print speed is 120 characters/second. Up to 136 characters can be printed per line at 10 CPI.
Its main features are: ● Compact desk-top dot matrix printer ● 136-column print ● Lightweight ● Low power-consumption ● High-quality print ● Bit image graphics ● Graphic Symbols ● Prints in six different languages ● High reliability ● Low cost.

P* $1225 ($1050 ex)
S $1275 ($1195 ex)**



F-10 Printmaster Daisy Wheel Printer

Print Speed: 40 CPS. **Print Method:** Static Print Impact. **Number of Printable Columns:** 136, 163, Variable. **Character Spacing:** 1/120 Inch (minimum). **Line Spacing:** 1/48. **Return Time:** 900 msec. **Line Feed Time** 40 msec. **Paper Width:** 406 mm (maximum). **Print Characters:** 96. **Printwheel:** Industry Standard 96 Character Wheel. **Interface:** Industry Standard 8-bit Parallel, RS232-C Compatible, X-ON, X-OFF, 12-bit Qume and Diablo Compatible. **Dimensions:** 574 mm W x 405 mm d x 153.5 mm H (22.5" W x 15.9" D x 6" H). **Weight:** 14 kg (30.8 lbs.) with cover and power supply. **Noise:** Less than 65 Db (1M from Platen, A Scale).

P* $1600 ($1450 ex) * Parallel Interface ** Serial Interface
S $1750 ($1510 ex)**

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Expiry Date.....
Name.....
Signature.....

SERIES 5000

As designed by ETI

PREAMPLIFIER

SPECIFICATIONS

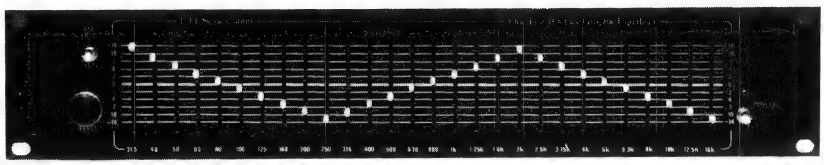
Frequency response:	High-level input: 15Hz-130 kHz, +0, −1 db Low-level input — conforms to RIAA equalisation, ±0.2 dB
Distortion:	1kHz <0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N noise:	High-level input, master full, with respect to 300 mV input signal at full output (1.2V): >92 dB flat >100 dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input, 50 ohm source resistance connected: >86 dB flat >92 dB A-weighted. MC input, master full, with respect to full output (1.2V) and 200 μV input signal: >71 dB flat >75 dB A-weighted.

POWER AMPLIFIER

Please note that the "Superb Quality" Heatsink for the power amp was designed and developed by Rod Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound. We also have a new range of rack mounting boxes which will be released soon.

SPECIFICATIONS

Power output:	100W RMS into 8 ohms (±55 V supply).
Frequency response:	8 Hz to 20 kHz, +0−0.4 dB 2.8 Hz to 65 kHz, +0−3 dB. NOTE: These figures are determined solely by passive filters.
Input sensitivity:	1V RMS for 100W output.
Hum:	−100dB below full output (flat).
Noise:	—116 dB below full output (flat, 20 kHz bandwidth).
2nd harmonic distortion:	<0.001% at 1 kHz (0.0007% on prototypes) at 100 W output using a ±56 V supply rated at 4 A continuous. <0.003% at 10 kHz and 100 W.
3rd harmonic distortion:	<0.0003% for all frequencies less than 10 kHz and all powers below clipping.
Total harmonic distortion:	Determined by 2nd harmonic distortion (see above).
Intermodulation distortion:	<0.003% at 100 W. (50 Hz and 7 kHz mixed 4:1).
Stability:	Unconditional



THIRD-OCTAVE GRAPHIC EQUALISER

SPECIFICATIONS

Bands:	28 Bands from 31.5 Hz to 16 kHz
Noise: 20 kHz bandwidth	<0.008 mV, sliders at 0, gain at 0 (−102 dB),
Distortion:	0.007% at 300 mV signal, sliders at 0, gain at 0; max. 0.01%, sliders at minimum.
Frequency Response:	12 Hz-105 kHz, +0, −1 dB, all controls flat.
Boost & Cut:	14 dB

1 UNIT $189
2 UNITS $359

EXTRA FEATURES OF OUR KITS
POWER AMPLIFIER
KIT PRICE $299 P&P $8.00

- 1% Metal Film Resistors are used where possible
- Prewound Coils are supplied
- Aluminium case as per the original article
- All components are top quality
- Over 200 Kits now sold
- We have built this unit and so know what needs to go into every kit
- SUPER FINISH Front panel supplied with every kit at no extra cost to you
- We are so confident of this kit that we can now offer it assembled and tested so that people who do not have the time can appreciate the sound that this applifier puts out. This is done on a per order basis delivery approx. two weeks after placement.

only $425

**All parts available separately for both kits.*

PREAMPLIFER
KIT PRICE $259 P&P $8.00

- 1% Metal Film Resistors are supplied
- 14 metres of Low Capacitance Shielded are supplied (a bit extra in case of mistakes)
- English "Lorlin" Switches are supplied no substitutes as others supply
- We have built and tested this unit and so know what needs to go into every kit
- Specially imported black anodised aluminium knobs
- Again as with the power amp we are offering this kit A & T at a price which we do not believe there is a commercial unit available that sounds as good. Same delivery as the P.A.

only $425

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'Dazzling' growth predictions for modems and interfaces

Only about 15% of today's personal computer users are equipping them with modems or other data interface devices, but this will soon go to 100%, according to a new report from International Resource Development Inc, a specialised US market research firm.

The report projects 'dazzling' growth in markets for local network interfaces, 1200 bps modems and other interface devices for the 'new generation' of personal computers and office workstations.

Demand in the US market will more than double in the next two years, according to the report, with 'spectacular action' in the full-duplex 1200 bps sector as personal computer users move up to 1200 bps from the 300 bps which most of them use today. The IRD researchers expect this demand to be satisfied by 212-A-compatible modems which provide full-duplex 1200 bps operation over a two-wire telephone loop. However, the report points to developments in Europe, related to demand for videotex modems, which could result in the availability of low-priced chips which are not compatible with the 212-A protocols popular in the US.

Major factors in stimulating the consumer market for modems and interfaces will be the increasing attractiveness of consumer orientated information and transaction services, such as bank-at-home and tele-shopping services. According to IRD, by the end of the decade more than half of all routine banking transactions will be conducted either from the home or from variously-located automatic teller machines. Tests during the past two years, conducted by more than twenty banks in the US, have shown that the convenience of paying bills, switching deposits etc, from home is a major attraction to the upper-income banking customer who hates standing in line for a teller.

With today's telebanking services being operated from home computers, and tomorrow's perhaps using videotex/TV terminals, the position of specialty terminal suppliers has become 'tenuous', according to IRD. Banking-orientated terminals may lose out to low-cost personal computers from Timex/Sinclair, Atari, Texas Instruments and, eventually, IBM.

IRD says that, in the US, there will be three million personal computers in place by the end of 1983, with about two million of them in the hands of consumers and the other million in businesses and schools.

In the office automation market it will be access to electronic filing systems which will be a major stimulant to the use of modems and local network interfaces, including the Ethernet protocol and the emerging TI/IBM baseband network technique. One of the factors leading to the rapid introduction of electronic filing will be the continued trend towards rapid increases in the storage capacity of magnetic disc systems, and the possible introduction of optical-disc-based electronic filing systems as soon as 1984.

Pointing to the continued development of digital networks, such as the packet-switching networks from GTE Telenet and Tymnet and the value-added Net/1000 soon to be introduced by AT&T's American Bell unit, the IRD report points out that these networks still required interface devices.

HP's 16-bit personal computer

A personal technical computer, the HP Series 200 Model 16, is Hewlett-Packard's first 16-bit personal computer.

Its 16/32-bit processor, 8 MHz system clock and software power provide very fast program execution.

It consists of a 229 mm diagonal CRT, a detached ASCII keyboard and a choice of single or twin 3½-inch microfloppy drives, each with 270K memory. A single microfloppy is also available with a 4.6M Winchester hard disk.

The Model 16 has a standard 128K memory, built-in graphics and is available with BASIC, HPL and Pascal language systems. Numerous HP applications software packs are available.

For further information contact **Hewlett-Packard, 31-41 Joseph St, Blackburn Vic. 3130. (03)890-6351.**

IBM to purchase 12% stake in Intel

The computer firm IBM Corp., one of Intel's largest customers, will acquire a 12 per cent stake in Intel Corp. for US$250 million.

The sale will make IBM Intel's largest single shareholder, surpassing Intel board chairman Gordon Moore, whose shares currently represent 9.8% of the company.

Under the terms of a deal, which is subject to review by the Justice Department or Federal Trade Commission, IBM will purchase 6 250 000 unregistered shares of stock at US$40 a share and will have the option to extend its position to 30% in future private buys. The upper limit, however, can be renegotiated by mutual agreement eight years after the stock sale takes place.

As part of the agreement, Intel's ten-member board of directors will be expanded by a single seat to be filled by a representative of IBM. According to the two firms, the IBM director will be 'excused from deliberations in which there is a potential conflict of interest as judged by the director or Intel'.

Industry observers see IBM's unprecedented move as an opportunity for Intel to resolve a cash shortage problem and an opportunity for IBM to assure the continued well-being of a semiconductor firm on which it is becoming increasingly dependent for microprocessors, memory parts and MOS technology. ●

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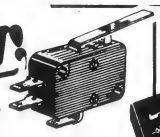

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this unit is a must where a postive snap action is required. Complete with 16mm actuator paddle. Cat. S-1920

FEATURES: 240V AC 10A contact rating. Body size: 10.5mm x 28mm. Quick connect terminals

Great for burglar alarms or as machinery limit switches

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A basic programming manual written just for kids! Written by an experienced teacher, it talks in a language the kids can understand. Cat. B-6190

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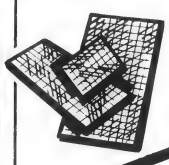

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This package runs either as a stand alone or interactively with your Stock Control & Pricing system. It provides full invoicing session summary reports, including sales tax & revenue totals. Allows for credits or returned items & even allows a mix of items being returned for credit with items being sold. Cat. X-3751

$99 ~~WAS $199~~

General Ledger

Lets you know exactly how your business is running & provide the necessary information to make business decisions based on accurate reports, as to your company's status. Cat. X-3752

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Now even small business (up to 100 employees) can 'go computer'! This program produces payslip, coin/cheque analysis, bank deposit advice, payroll tax report and group certificates, as well as catering for different deductions, hourly pay/monthly salary, cash/cheque or deposits, etc. Cat. X-3769

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Each pack contains hundreds of words, letters, numbers & symbols for quick easy labelling of electronic equipment. These are transfer sheets that are easily applied by burnishing.

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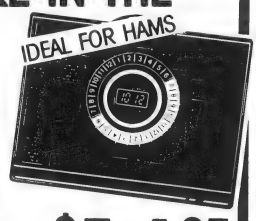
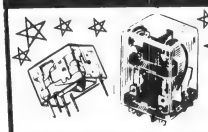


Great for radio hams, telephonists, international businessmen or anyone who wants to know the time anywhere in the world! Has LCD & an easy to read scale dial. Cat. Y-1054

Value $14.95



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Ultra Miniature PCB Mounting

Low cost miniature relay for projects with little room to spare. Fits standard 2.54mm matrix. Cat. S-7112

Contact Current (max.): 1A
Contact Voltage (max.): 100V AC
Nominal Coil Voltage: 12V
Coil Resistance: 320 ohm

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High Rating Power Relay

Small high capacity relay ideal for power switching. Great for switching 240V projects from transistor or IC control. Cat. S-7200

Contact current (max.):10A
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Nominal coil voltage:12V
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12V Power Supply

For any equipment requiring 12V DC at a max. of 200mA. Simply plugs into any 240V AC outlet. Suggested uses would be with handheld transceivers when used as base stations & the older type portable radio that worked on 12V DC etc. Cat. M-9550

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A neat horn type speaker with electronic siren module built-in. It delivers an ear-splitting penetrating wail that can be heard for blocks. It's weatherproof, so it can be indoor or outdoor. Operates from 12V. Cat. L-7026

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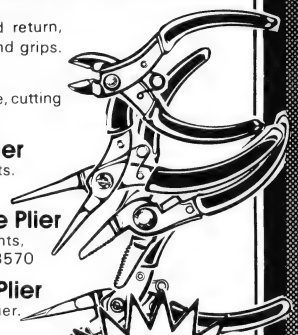
Resists rust, spring load return, insulated, easy grasp hand grips.



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Ideal for small components, confined places. Cat. T-3570

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Long reach in a small plier. Cat T-3565

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STOCK UP NOW!

These are resin dipped electrolytic type. They offer very low leakage and a high capacitance in a tiny package. Ideal for PC board mounting.

Value in UF	Voltage	Cat. No	Value in UF	Voltage	Cat. No.
0.1	35	R-4700	4.7	35	R-4740
0.22	35	R-4705	6.8	35	R-4745
0.33	35	R-4710	10	25	R-4750
0.47	35	R-4715	15	16	R-4755
1.0	35	R-4720	22	16	R-4760
1.5	35	R-4725	33	10	R-4765
2.2	35	R-4730	47	6.3	R-4770
3.3	35	R-4735	100	3	R-4775

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From 0.1uF to 6.8uF 60¢ 10 up 55¢
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20 TIME ZONES

WORLD TIME DUAL MELODY ALARM

WAS ~~$64.95~~

Cat. Y-1051

Tell the time anywhere in the world! This fantastic watch not only displays local time but 20 different time zones as well.

- **Dual melody alarm**
- **LCD displays date, alarm, home time & 20 different world times.**
- **World graphic display**
- **Night light**

Great for the businessman, amateur radio operator or anyone who wants to know the time around the world.

$49.50

DIRECT IMPORT YOU REAP THE BENEFIT!

ALL ONE PRICE $7.75

BUILD YOUR OWN MINI-SYNTHESIZER

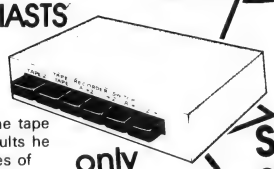
The Incredible Electrochune

only $45 WAS ~~$75~~

The Electrochune is a keyless monophonic organ and uses the circuitry of a synthesizer to give variable attack/decay times, tremelo and square/sine wave output mixing. It even has a built-in amplifier and speaker with separate volumn control. Complete with plugpack and full instructions. Cat. K-3506

AUDIO ENTHUSIASTS

TAPE DUB BOX



An easy way for the tape buff to get the results he wants without miles of cords, plugs & mess! Simply switch between the inputs & outputs required! Cat. C-7220

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SYSTEM 80 MAKES MUSIC

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EPROM memory for HP-41C/CV

An EPROM based ROM emulator, independently manufactured in the USA is now available in Australia.

Known as the HHP-16K it is a ROM emulator device designed for use with the Hewlett-Packard 41C/CV calculator hand-held computer. It offers large scale program storage of 4K, 8K or 16K and when plugged into any port it is directly accessed like any standard ROM.

The HHP-16K is 147 mm x 91 mm x 28 mm and is HP-41C/CV powered having a very low power requirement. On disconnection there is no program loss.

Three ZIF (Zero Insertion Force) sockets are used to hold the EPROMs which are a combination of type 2716, 2732 and 2764. The EPROM box address is DIP switch selectable.

An EPROM burning service is available for the transfer of programs from HP-41C/CV cards or cassette storage systems.

Enquiries can be made to **Dataprom Pty Ltd, P.O. Box 476, Hurstville NSW 2220. (02)587-9701.**

Atari troubled, to phase out Model 400, introduce 64K Model 1200XL

Despite predictions that the US personal computer industry will crack US$3 billion turnover this year, Atari seems to have fallen back from the crest of the wave and will restructure its computer lines this year.

Commodore and Texas Instruments cut Atari's lead in the home computer market last year, the VIC-20 being the highest selling unit in the US now. TI's late introduction of the TI 99/4A last year further eroded Atari's hold in the low price end of the market.

In mid-December, Atari's Home Computer Division announced it would open additional manufacturing facilities in the Far East and add more production shifts to its California plant to give it more leverage in the home computer market currently experiencing a round of sharp price reductions.

Competitive strategems being effected include: • price cuts for the models 400 and 800; • phase-out of the 400 in favour of an updated model; • introduction of its anticipated Model 1200XL.

It seems that aggressive pricing by the competition has been a major factor in the demise of Atari's share in the US home computer market. Atari has held back from dropping the price of the 400 in order to avoid infringing on its video games market and to help recoup comparatively high costs.

The Model 400 now sells for US$200, directly against the TI 99/4A and VIC-20. The 400 is expected to be phased out later this year, but no details of an 'upgraded' replacement are available at present.

The Model 1200XL commenced shipping in January and was expected to retail around the US$900 mark. It is a 6502-based machine with 64K of RAM, a full keyboard plus 12 user-function keys and a self-diagnostic program.

The 1200XL has one-touch cursor control, 256-colour availability, four 'voices' that cover 3½-octaves plus two controller ports for joysticks, paddles and a numeric keypad. Australian release was not known at press time.

New agent for Ye-Data floppy disk drives

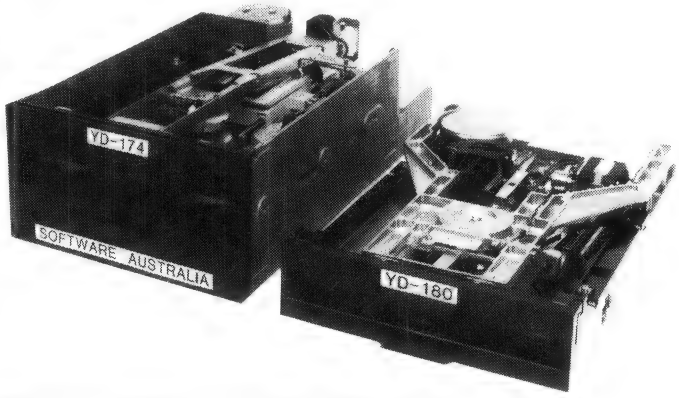
Software Australia has been appointed as an agent for Ye-Data products and is marketing 125 mm (five inch) and 200 mm (eight inch) drive ranges.

The company will concentrate sales on the YD-180 eight inch slimline and YD-174 normal size eight inch drives. Both drives have a three millisecond track-to-track stepping rate and will support single and double-density, single and double-sided operation using the latest technology steel band positioner.

Software Australia says that it has developed an attractive price schedule for all end users, from OEMs to single purchasers.

Ye-Data will also market, through Software Australia, the YD-274 5¼" double-sided, double-density floppy disk drive this year. The larger capacity 80 track YD-280 and the YD-380T will follow soon.

Any company interested in Ye-Data products should contact **Software Australia, 2 Somerfield St, Mt Gravatt Qld 4122. (07)349-9122.**



QT Computer Systems 16-bit computer

QT Computer Systems has released its first 16-bit microcomputer system with the 8086 microprocessor.

This system comprises 128K to 256K of RAM, two RS232 communication ports with selectable baud rates of 75-19.2K bps, one parallel printer port, floppy disk controller and hard disk controller.

It features a fully integrated 380 mm green phosphor CRT with anti-glare filter, 66 lines x 80 characters per line and includes BASIC, CIS COBOL and CBASIC 86. WordStar and various other application programs are also available.

For more information on this system contact **QT Computer Systems, 41 Sydney St, Marrickville NSW 2204. (02)519-2680.**

Floppy disk controller kit

The SYM-1 Users Group in the US have released an economical floppy disk controller kit for the SYM-1 and AIM-65.

Designed by Synertek Systems, the kit features quality through-plated holes, solder mask, silk screened pcb with sockets for all ICs and a disk drive cable.

Called the PER-SYM-ONE it is capable of supporting two double-sided density 5¼" disk drives for a total of 640K bytes. It connects directly to the SYM-1 Econnector or may be installed in a motherboard under the SYM. A 2K SYM DOS on EPROM is provided with a complete source listing. The DOS allows saving and loading of programs using SUPERMON, BASIC and RAE. Additional utilities are provided.

These kits are available from **Energy Control, P.O. Box 6502, Goodna Qld 4300. (07)288-2757.**

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K/NAR 397

The Sun comes up in Australia

It was no coincidence that the TCG Group announced it had been awarded the Australian distribution rights for the Sun computer graphics workstation at the same time the movie 'E.T.' began screening in Australia.

'E.T.', the latest box office success from Steven Spielberg, used the facilities of Lucas Films in the creation of special effects, for video editing, previewing and control of video equipment, editing machines and video disks. Lucas Films has 18 Sun systems which it uses for production and control work. Filmmaker George Lucas and Spielberg, in collaboration, have produced some of the world's highest grossing and most successful films.

The Sun system provides individual users with the power of a mini on their own desks. Networking means there is no degradation or downgrading of performance in a multiple user situation because each has his own processor.

The system has powerful graphics capabilities with high quality resolution. The system can be upgraded at a relatively low cost with additional workstations, as disk based units or networked together. It offers a network system to support such diverse applications as CAD/CAM, engineering and robotics as well as the graphics arts, typesetting, office automation and executive administration.

An integral Ethernet local area network connection provides a high speed interface (one million characters per second) and an advanced user interface includes high resolution bitmap graphics capability, a 'mouse' pointing device for graphic input and a powerful Motorola 68000 microprocessor which operates at 10 MHz with no wait states. It is claimed to be as powerful as a VAX II/780 for non-floating point work.

Using the Intel Multibus as the I/O bus, the Sun workstation is expandable with a variety of peripheral controllers and off-the-shelf board level components.

For more information contact the **TCG Group, 30 Balfour St, Chippendale NSW 2008. (02) 699-8300.**

Sinclair ZX software

Gloster Software has added to the range of software available for the ZX81 and ZX80 8K computers.

The 'Household Management Pack' features a budget system which not only allows for inflation and other changes in income and expenditure over time, but makes possible introduction of irregular variations, seasonal items and once-only items. It can handle up to 255 entries. After simulating transactions over a given period, the user is told how to maximise investments in common maturity terms based on the resultant cash flow.

The system is readily expandable as the data used is saved separately from the programs. Also included in the pack is a planner diary generator which enables the family to keep track of each other's activities and avoid engagement clashes, allowing three time periods per day. It requires 16K RAM and a printer is helpful but not essential.

Gloster Software has also expanded its 'Data Pack'. Besides allowing data manipulation and taped data files, program merging, line re-numbering and bulk line deletion, the system now features a command to verify program saving.

Other new items include 'ZX Space Trek' (ZX81 only) and 'Casino' (four game pack).

Enquiries should be made to **Gloster Software, P.O. Box 5460CC, Melbourne Vic. 3001. (03)232-2398 ah.**

Atari gets bar on Commodore stick

In the US, Commodore Business Machines, manufacturer of the Vic-20 computer, have been barred from making and distributing joystick controllers which imitate the controller developed by Atari for its Video Computer Systems and home computers.

So Atari has won the first round in its patent infringement suit against Commodore. Shortly before the US District Judge handed down his decision Atari and Commodore reached an agreement that Commodore would temporarily suspend manufacturing and wholesale sales of its Vic-20 joystick controllers. Commodore did not admit to any wrongdoing in signing the agreement.

Commodore said that it has redesigned its Model 1311 joystick and has been marketing the altered version with adjustments. But Atari considers that this is also a patent violation and is seeking action against Commodore for making and marketing it.

Club Call

A MicroBee Owners Club would be a great idea. If you cannot find a club or you are interested in starting a club then send a SSAE to Colin Johns, 6 Tunks St, Waverton NSW 2060 and he will send you the latest information.

ZX81 users can now contact the ZX81 **Software Exchange** by sending a SSAE to ZSE, c/o Chris Tueno, 5 Muir St, Mt Waverley Vic. 3149.

The **Australian Sirius Users Group** is being formed to look after the needs of Sirius One and Victor 9000 computer users. This national group, founded by microcomputer enthusiast, Stephen Page, will issue a newsletter containing programming tips and information about new products, and will develop a software library.

Membership in the group will be free of charge. For a membership form write to the Australian Sirius Users Group, P.O. Box 204, Chermside Qld 4032. (07)350-2611.

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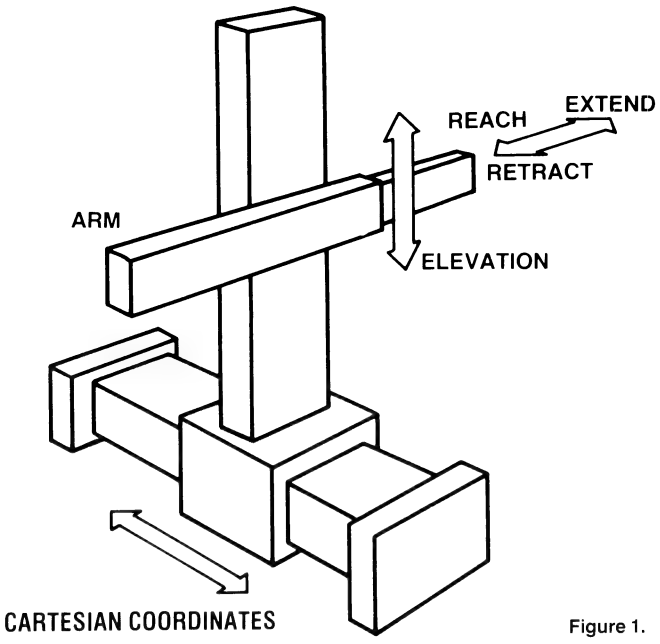


Figure 1.

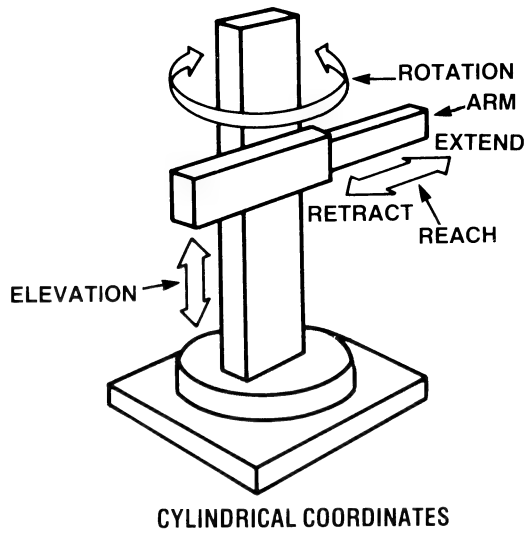


Figure 2.

Robotic arm techniques

The problems surrounding the remote manipulation of objects under the control of a computer have long been a topic of discussion between and among mechanical and electronic engineers and scientists. This article takes a brief look at the four fundamental systems that have been evolved and suggests an approach for hobbyists interested in robotics.

Roger Harrison

MANIPULATING OBJECTS by means of a robotic arm requires a 'marriage' between mechanical engineering and electrical engineering if one is to arrive at an effective system. Four basic coordinate systems for moving an 'arm' have been evolved. Each has its merits and disadvantages. The four systems are:

1. The cartesian coordinate system.
2. The cylindrical coordinate system.
3. The polar coordinate system.
4. The revolute coordinate system.

The number of fundamental motions that a robotic arm can perform is determined by the number of axes employed in the system. The number of axes are often referred to as the **'degrees of freedom'.** Thus, a robotic arm that can move on four axes is said to have 'four degrees of freedom'. The number of axes, and thus the degrees of freedom, endemic to a particular arm are important when considering the tasks it may have to perform. Another important consideration is the 'work envelope'. If you put a paint brush on the end of a robotic arm and then had the arm describe its complete area of movement (with the arm fully extended), the brush would 'paint' a surface in the air — that surface would be its work envelope.

The four basic systems illustrated have only three degrees of movement but vastly different capabilities.

The cartesian coordinate system is illustrated in Figure 1. Here, a pillar can move back and forth along a base. The arm is mounted on the pillar and can move up and down it (elevation). The arm is in two pieces, one piece being capable of extension and retraction.

As all movements are linear, the cartesian system has a work envelope shaped like a cube.

By fixing the pillar of the cartesian system and making it rotate, we make the cylindrical coordinate system, so called because it has a cylindrical work envelope. Two linear movements are left and an angular movement added. Somewhat more complex movement is possible with this system, over and above the cartesian system.

By pivoting the arm around a rotating pillar, one produces the polar coordinate system. This has a work envelope shaped like a half-sphere and the complexity of motion is another step better than the previous system.

The revolute system, Figure 4, emulates the human arm. It is pivoted in two places and can rotate on its base. All movements are angular and, for a three degrees of movement system, it is capable of very complex motion. The work envelope approximates a major portion of a sphere as the arm can be made to reach below the plane of the base.

A really complex system having ten degrees of freedom is illustrated in Figure 5. This is a combination of the cylindrical, polar and revolute systems mounted on a mobile platform.

Gripping

An arm is useless without some mechanism to grip the 'work objects'. For hobbyists, a simple jaw grip system is probably the easiest to implement. Hinged tongs with a spring system to hold them open and a solenoid or motor to pull them shut are simply constructed and controlled. The general principle is shown in Figure 6.

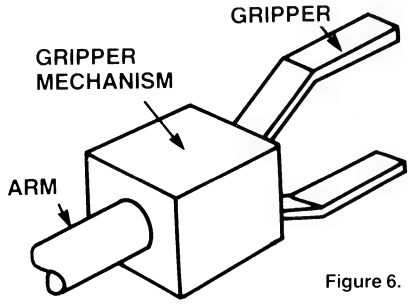
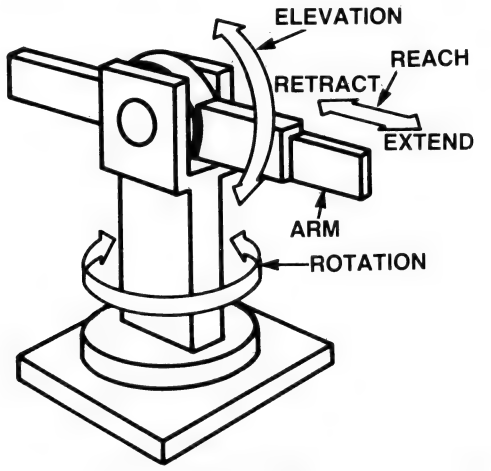
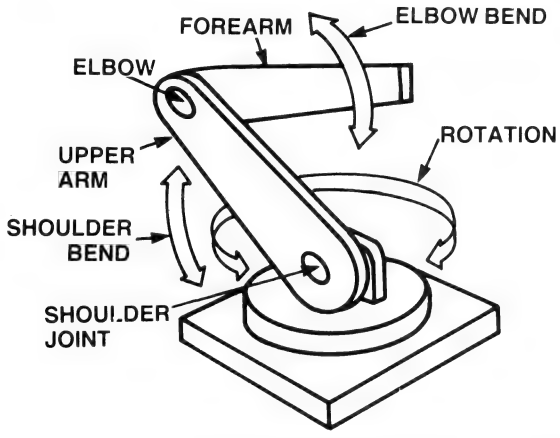


Figure 6.



POLAR COORDINATES

Figure 3.



REVOLUTE COORDINATES

Figure 4.

Drive systems

Industrial robots require physical strength and thus use large, multiple-horsepower electric motors and/or pneumatic or hydraulic drives. Even in relatively small industrial robot arms, hydraulic systems have many advantages. At present, such systems have distinct disadvantages for the hobbyist, not the least of which is cost.

Small electric motors are the most cost-effective drives for small arms and electric/electronic control is readily implemented and interfaced to a computer system.

Grasp the nettle

'Personal robotics' is following in the footsteps of personal computing. In fact, they're related in many ways — via the microprocessor.

In early-1982 we published the construction details for an Australian-designed and manufactured 'turtle-style' robot — the Tasman Turtle, that was controlled by a microcomputer system via an interface. It created a great deal of interest. Since then we have searched for other robotics projects of wide appeal and within the means of enthusiastic constructors.

Late in 1982 we found a British firm who had designed and was manufacturing a reasonably-priced robotic arm kit employing the revolute coordinate system, called 'The Micro-Grasp'. The firm was Powertran. Local kit and component supplier, Jaycar, sought and obtained the agency for Powertran kits — which have a much-envied reputation for quality in Britain — and we sought the rights to publish the project here.

The Micro-Grasp is an articulated arm jointed at shoulder, elbow and wrist positions. The entire arm rotates about the base and there is a motor driven gripper. Each of the arm movements is servo-controlled i.e: there are position sensors feeding back information to the interface board where it is compared with the programmed intended position and automatically takes corrective action.

This'll grab you! The Micro-Grasp, a computer controlled robot arm project, scheduled to be described in April ETI, features four degrees of freedom, a motorised gripper and simple interfacing.

This servo action is independent of the computer, greatly simplifying the software to drive the robot and all programming is carried out with a small number of BASIC commands.

The interface board is memory mapped using only 64 bytes at any of 1024 switch selectable locations. The control signals required are the address buss, data buss, write and memory request or alternatively I/O request if it is preferred to operate the robot as an I/O device.

The edge connector format could be arbitary as the board is suitable for almost any computer.

The newly-formed Cybernetics division of Jaycar will be importing and marketing the Powertran Micro-Grasp in Australia.

The Micro-Grasp project is scheduled to be published in the April issue of ETI — don't miss it! ●

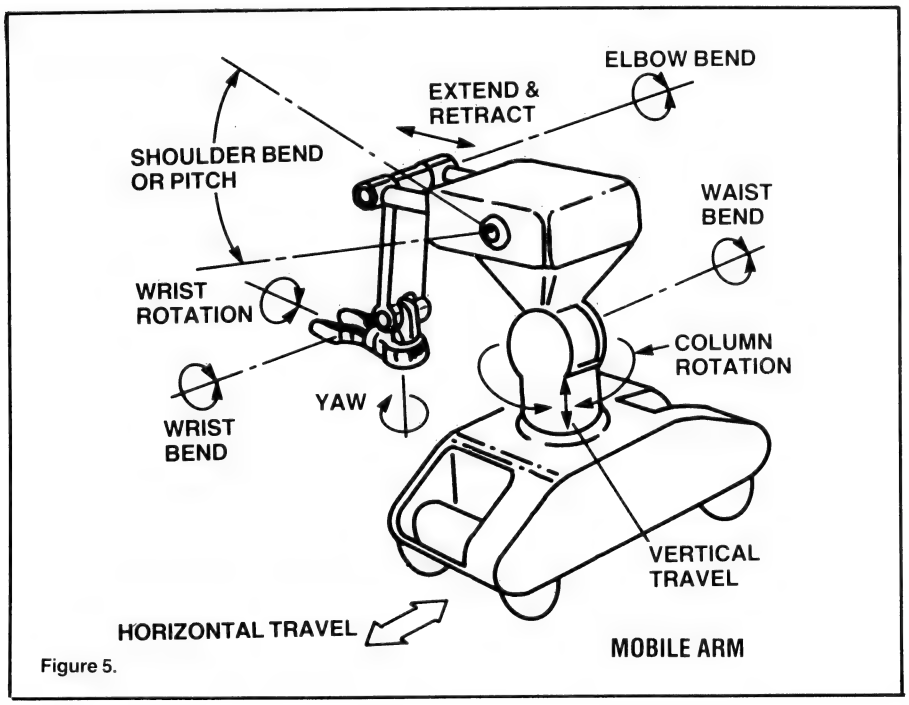


Figure 5.

The SME Systems 'Unicorn' computer

Do all Z80 systems look alike to the user? In some ways yes, and in other ways no. They'll all run CP/M, Wordstar and other useful utility programs, but monitor stunts vary from system to system. With the Unicorn our reviewer found himself on the horn of a dilemma . . .

Mort Street

RECENT ADVERTISEMENTS for small computers have featured such eye-catching shots as a small child holding the machine up with one hand. This is definitely not possible with the 'Unicorn'. In fact, I came within about 1.5 Newtons of getting a hernia just lifting *part* of the system.

The monster comes in four parts — first, a terminal. This is a pretty standard Televideo model 925, with an SME Systems sticker on the front of it. So far, so good. Next is the printer. This is a Microline u84, again with an SME sticker on it. Then comes the guts of the system — the CPU box. This is a very well-built unit (if the weight of it is any guide) with a keyswitch and a reset button on the front, and the usual socketry on the back. There is one socket for the disk drive, one for a 9600 baud terminal (RS-232), one for a 1200 baud printer (also RS-232), and one for a Centronics-type printer. There are also two power output sockets, which presumably are for the printer and the disk drive unit.

The disk drive is a dual eight-inch unit, built into the same sort of cabinet as the CPU.

Getting the computer onto a table was my first problem. That required a lot of sweating and swearing, and also a short prayer that the table would hold. Fine. Now I had the unit where I wanted it. I decided to plug it all together. Then my problems really began.

Like any conscientious reviewer, I first looked through all of the manuals. There was a SuperCalc user's guide. Fine. I would need that later. There was a Microsoft BASIC reference manual. That I would need later, too. There was a Wordstar training manual, and a set of Wordstar reference manuals. Good. Then there was a CP/M manual. Great.

Up to this time, I had seen nothing to tell me how to turn the machine on. Picking up the last manual (which advertises itself as the 'SME Systems Technical Manual'), I settled down to read all about the system. Page 3 says "SME SYSTEMS MONBIOS". I assume that by that they mean their monitor and I/O system? Turning the page, I was confronted by an assembly listing of the complete monitor.

Aghast, I turned pages till I came to the end of that — then I was given an I/O port map, followed by a photocopy of the Zilog specs on the Z80 and associated chip set. Wading through this, past the specs for various other chips inside the machine, I came at last to a piece of blue cardboard. This was, in fact, the end of the book!

Slim. The 'Unicorn' is a specially-built slimline S100 buss system. The CPU unit (top right) employs a 10-slot vertical motherboard with off-set slots to achieve the low height. The twin 8" disk drive unit sits beneath it. The Unicorn can be used as a single terminal multi-purpose machine or built up to a 15-user system employing a range of SME system cards.

Amazed, I looked again through the other volumes. Was there anything I had missed? Perhaps even a manual for the monitor? No such luck.

I realised then that reviewing the system was going to be a difficult task — with no documentation to tell me how to operate the thing, never mind describing what hardware was in it, reviewing the 'Unicorn' was not going to be simple*.

The system documentation consists of four documents:

1. The manual I just described, giving monitor listing and chip technical data.
2. A piece of paper in each disk drive box that told me to "REMOVE HEAD PROTECTION SHEET BEFORE APPLYING POWER".
3. A six-page document describing the extra CP/M files supplied with the system.
4. Hand-written sticky labels beside the sockets on the back of the CPU unit.

. . . and that is it. Oh well, I thought, what you get is what you get. So I plugged the right plugs into the right sockets (I know they were the right ones because it worked), put a CP/M disk into the left-hand disk drive, and turned on the power.

Nothing happened. Well, the RESET button lit up, and the fans on the two units started up. The cursor even appeared on the monitor. But nothing else happened.

Well then, I thought, SME have obviously decided not to provide power-up reset. So I pressed the RESET button.

The monitor came up with the message:

```
SME SBC800 Monitor V 2.0
M›
```

. . . great. But the disk hadn't started up, so I was obviously still in monitor. And the monitor documentation consisted of an assembly listing . . .

No, I thought, these guys have got to be joking.

Taking an inspired guess, I entered a C (for CP/M — haven't you read 'Zen and the Art of Motorcycle Maintenance', about inspiration and engineering?) and pressed RETURN.

Sure enough, the disk started to move, and I got the message:

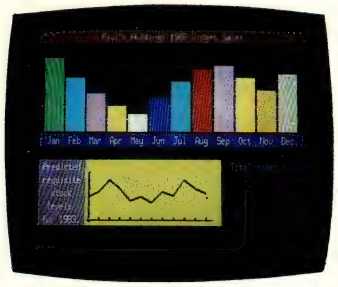
```
64K 2:1 Double Density CP/M 2.2,
By SME Systems
A›
```

From then on in, it was plain sailing. I assume by the message that the machine has 64K of memory, that the disk drives are double density, and that CP/M 2.2 is supplied with the system.

— continued on page 89. ▶

A STAR IS BORN

Business Graphics



Arcade Games

Educational Programmes

NSW EDUCATION DEPARTMENT APPROVED

- **Microbee — Australia's own educational and personal computer!** (Approved by NSW and WA schools.)
- **Designed and manufactured in Australia.**
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- **More computer for your money — more software support.**

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CEAT2612

MICRO WORLD UPDATE

NEW 'PLUS' SERIES WITH EXTRA FEATURES

16K PLUS

The 16K PLUS with features such as built in music generation, high and low resolution graphics, with a screen display of 16 lines each containing 64 upper and lower case characters. When you also consider all of the standard extras like continuous memory, built in printer and input/output interfaces and parallel port, 4.5 volt battery back-up and self testing BASIC in ROM, the MicroBee 16K PLUS is unbeatable in its class.

32K PLUS

All of the standard features of the 16K PLUS with twice as much usable RAM. When you add the new Word Bee ROM Pack, you have a powerful word processing capability which does a lot more than play the many games available for the MicroBee. Add a printer and maybe even the Tasman Turtle and just see what you and your family can now do with your home computer.

64K PLUS

The MicroBee 64K is equipped with 56K of user RAM with Battery backed continuous memory and has built-in 80 x 24 screen format as well as 64 x 16 line. All characters are upper and lower case and powerful graphics are readily available. A value packed exclusive feature of the MicroBee 64K PLUS is that it can double as an ADM3A Terminal operating in serial mode at either 300 or 1200 baud (full or half duplex). You can add a modem and use your MicroBee 64 as your personal information window to the world.

A better Bee for '83

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The Australian Personal Computer Show
10th - 12th March
and see the new Colour Bee, 64K Bee with low cost disk drives and the Bee Modem/Networking.

More Features . . . More Software . . . More Computer for Your Money!

ROM PACKS

WORDBEE — a full featured Wordprocessor.

Convert your MicroBee into a professional quality wordprocessor. Suitable for any 16K or 32K MicroBee. Enables the user to select either BASIC or WORDBEE/MONITOR as required.

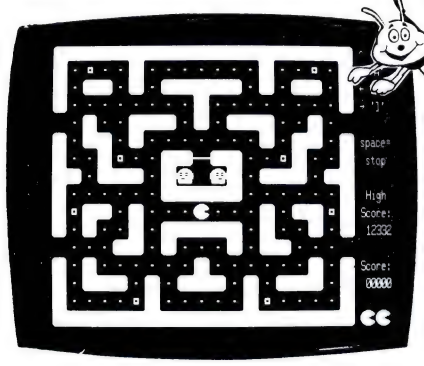
WORDBEE is friendly and easy to use, and has extensive HELP files built into the ROM. It uses the familiar control key and dot commands from WORDSTAR, the on-line help from WORDMASTER and the on-screen formatting from ELECTRIC PENCIL.

EDASM — MicroBee monitor and Z80 Editor Assembler.

This ROM pack converts your MicroBee into a combined BASIC/MACHINE CODE/ASSEMBLY LANGUAGE unit and is ideal for those who need to develop programs in machine code. Built in commands include EXAMINE and MODIFY memory, BLOCK MOVE and FILL memory, EXECUTE a program, READ and WRITE to cassette tape, SEARCH and COMPARE code and RETURN to BASIC.

NETWORK 1

By popular demand we are making this ROM available for networking to other computers over the telephone lines. Contains the software to convert any 16K/32K MicroBee into a 'DUMB TERMINAL'.



ARCADE GAMES

Ideal for parties, these action games make full use of the superb graphics and sound effects of the MicroBee. Your friends and family are set for hours of fun and excitement!

"ROBOT MAN" — A New Release.

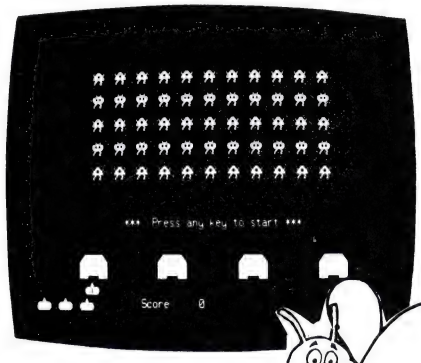
You must move about the maze eating up the power food. Watch out for the Robot Men as they are programmed to destroy you before you complete your mission!

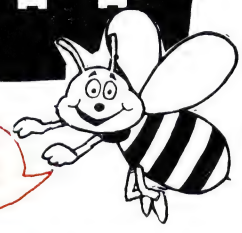
"MICROSPACE INVADERS"

Yes the arcade favourite! This fast-moving version was written especially for the MicroBee by Tim Morris-Yates and has become one of the most popular programs yet released.

"MISSILE WARS"

Equipped with radar and ray cannons your mission is to defend your city against the attacking alien invaders. This game is fast moving and very exciting. The graphics and synchronized sound effects will really involve you in the game.





EDUCATIONAL SOFTWARE

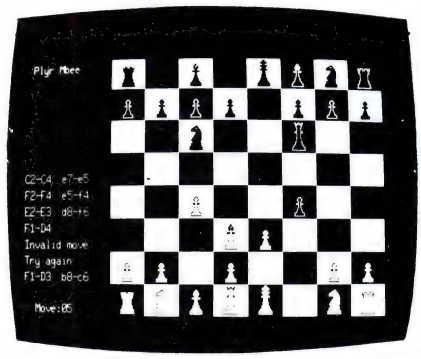
Because the MICROBEE is recommended for use in Australian schools, considerable software is now being written to match the curriculum in several States. Demonstration programs are available on EDPACK I and EDPACK II. Watch for the release of OZLOGO, PASCAL in the near future!

TURTLE GRAPHICS

A very clever program allows the student to use the MICROBEE to draw using high resolution turtle graphics. A booklet of procedures is available from the NSW Department of Education. This is a very powerful graphics program which uses the PCG facility in the MICROBEE to its full extent.

WORK-A-BEE

A new release. WORK-A-BEE is a program which can actually write educational programs almost automatically! Any teacher with little or almost no knowledge of BASIC can insert details as to question and answer, number of tries, marks per question and other controls. Any CAI program can be saved and reused and subroutines have been included to enable the student to go back over his work, printing answers, avoid error traps etc.



FAMILY GAMES

"CHESS"

Match your skills against the MicroBee chess master. You can select from 1 to 6 ply and also analyse any position. A built-in 'HELP' feature enables the computer to play YOUR current move.

"CONCENTRATION"

A real family favourite for 1 to 4 players to test your memory skills. If you call one player MERLIN, the computer will play that turn so watch out!

"HOUSE OF FRANKENSTEIN." A New Release

The first adventure game for the MicroBee. Needs a 32K machine and can take weeks to resolve. Has built-in game save facility to re-load the game and resume play from your last session.

"BIORHYTHM/CALENDAR MAKER"

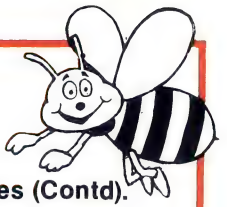
Ideal for parties or carnivals. Requires a serial printer. You can print BIORHYTHMS for anyone — just enter their name and birthday!

COMPUTER UTILITIES

These programs are included as enhancements of the MicroBee computer itself.

PCG TUTORIAL — ESCKEY — and DISSEM are three of them.

MicroBee PRICE LIST



HARDWARE

MICROBEE PLUS SERIES

(See features on previous pages)

110.017	MicroBee 16K PLUS	$449.00
110.032	MicroBee 32K PLUS	$549.00
110.064	MicroBee 64K PLUS	$699.00

MONITORS — Three to choose from or you can convert your old black and white television. We recommend the KAGA Green Screen with 18 Mhz bandwidth for serious users and the new MicroBee Monitor with built-in power supply for general purpose, but quality Green Screen performance.

150.020	KAGA High Resolution Monitor	$299.00
150.022	MicroBee Hi-Resolution Green Screen	$199.00
150.025	B. & W. Monitor (converted television)	$149.50

CASSETTE RECORDER —

High reliability cassette recorder such as National or Sanyo is recommended. We will supply with your MicroBee.

150.030	High reliability cassette recorder	$39.50

BLANK DATA CASSETTES —

For saving your own programs. Made in Australia to our specifications.

110.310	C10 Data Cassette	$1.20
110.311	C20 Data Cassette	$1.30
110.312	C30 Data Cassette	$1.40

CASSETTE BASED SOFTWARE

NEW RELEASES —

(As featured previous page).

250.042	Robot Man	$14.75
250.048	Work-A-Bee	$14.75
250.049	Turtle Graphics	$14.75
250.045	House of Frankenstein	$14.75

OTHER MicroBee Cassettes

(Also featured previous page)

250.020	Microspace Invaders	$14.95
250.036	Missile Wars	$9.95
250.022	Chess	$9.95
250.021	Concentration	$9.95
250.027	Biorythym Calendar	$9.95

MORE MicroBee Cassettes

Z TREK — Captain! The warp drives are disabled, the Klingons are closing in on us, what will we do? In Z Trek YOU are the captain of the starship Enterprise, your five year mission to search out the Klingons and destroy them. There are ten levels of difficulty (0 - 9). Beware of this game — it is strangely addictive.

250.032 Z Trek $9.95

WUMPUS — THE ADVENTURE GAME

Have you ever played the game Wumpus? If you liked it then you'll like this! The object is the same as the earlier version except that it's a lot harder. To say any more would spoil the fun. Good Hunting!

250.031 Wumpus $14.75

ESC KEY — This is a program for all of the two fingered typists in the world. The program allows you to enter BASIC key words in an abbreviated form. For instance, instead of typing "list" the user would type "esc" and then "1". The computer then types out the rest of the word for you. Suitable for 16K and 32K machines only.

250.041 ESC Key $9.95

GRAPHIC GAMES — This cassette contains five programs, 'Poker', 'Slots', 'Dodgem', 'Picture', 'Richochet'. 'Poker' is the main program on the cassette. In this game the computer is the bank and you have to beat it at Draw Poker. Warning — the computer plays a cunning game and is quite prepared to bluff! 'Slots' is a one armed bandit and for 20c a go you can try your luck. In 'Dodgem' the player must guide his car through a forest to the bottom of the screen — this game allows you to drive a car without the random breath tester getting you!! 'Picture' is an excellent game for the children. The final program on the cassette is 'Richochet', where the player is to decide when to fire a bullet through a hole in the wall. If you hit the wall you're dead.

250.035 Graphic Games $9.95

PCG SAMPLER — The PCG Sampler cassette has eight programs on it. These programs show you how the PCG works and demonstrates its capabilities by way of games etc. The cassette is excellent for both beginners and experts. It allows you to design your characters on the screen, so you can see exactly what you are creating. Suitable for all MicroBees.

250.037 PCG Sampler $9.95

STARSHOOT/HANGAMAN — Starshoot is perhaps one of the most deceptive games available on computer. It appears to be very easy: it isn't. Hangman is based on the popular school game that everybody knows.

250.026 Starshoot/Hangman $7.95

ELIZA — Want someone to talk to? Eliza is possibly the person for you. (If you can get her to shut-up). Eliza is a program that demonstrates artificial intelligence. Eliza is prepared to talk about life, the universe and everything.

250.028 Eliza $9.95

TYPING DRILL/SOLITAIRE — Want to become a touch typist? Typing Drill enables you to learn touch typing without paying an exorbitant fee to learn. Solitaire is a game in which the object is to remove all of the "pegs" from the board, leaving one peg in the centre of the board. Sounds simple, but, it requires skill to master it.

250.023 Typing Drill/Solitaire $9.95

TARGET — Target is a game of hit and miss. Your task is to aim the cannon at the bottom of the screen and shoot down the U.F.O.'s (ET watch out). There are nine levels of play to this entertaining game thus making it suitable for any player. Suitable for all MicroBees.

250.024 Target $9.95

LUNAR LANDER/HURKLE — Crash! This game was probably originally designed by N.A.S.A. scientists — after all it's much cheaper than Apollo. The object of Lunar Lander is to land your space craft on the moon without using up all of your fuel. Don't laugh and say that's easy: it isn't.
For a description of Hit the Hurkle please see the Kids Pack.

250.025 Lunar Lander $7.95

MASTERMIND/NIM — The Mastermind on this tape is quite similar to the version on the Kids Pack except for the fact that you can enter up to nine digits as the mystery code. This makes the game extremely interesting and mind bending. Nim is also played in a similar style to the version in the Kids Pack except that you can have up to 9 piles of 'matches'.

250.030 Mastermind/Nim $9.95

ROM BASED SOFTWARE

(See features on previous page)

250.003	Editor Assembler	$59.50
250.040	Word Bee ROMPAK	$89.50

Make a BeeLine for your MicroBee Computer Shop today!

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Specialty Enterprises,
6th Floor,
104 Bathurst St. Sydney.
Phone: 267 7747.

GOSFORD:
Applied Technology,
1 Debenham Rd. West Gosford.
Phone: (043) 24 1022.

CANBERRA:
MicroBee Computer Shop,
Level 1, Cooleman Court,
Weston, ACT.
Phone: (062) 644 277.

MELBOURNE:
Computerland Sth. Melbourne,
19 - 37 Albert Road,
(Cnr Kingsway & Albert Rd.),
Melbourne.
Phone: 268 6647.

Specialty Enterprises,
1st Floor,
305 Latrobe Street, Melbourne.
Phone: 67 8811.

BRISBANE:
Specialty Enterprises,
6th Floor, 246 Queen Street,
Brisbane.
Phone: 229 2450.

PERTH:
Altronics
105 Stirling St, Perth.
Phone 328 1599

NEW ZEALAND
Checkpoint Computers,
36 Main Road, Tawa,
New Zealand.
Phone: (4) 32 6988.

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▶ — continued from page 84.

Now, there is no point in me reviewing CP/M itself, or Wordstar, or Supercalc or any of the other software in the system, because this is a review of the 'Unicorn' itself.

So that leaves the special files that SME give with the system, which were described in their little six-page leaflet.

The first is **MCOPY,** which is a disk copy program. Then there is **BAUD2,** which changes the baud rate for the printer or terminal. **FINDBAD** checks the disk for bad sectors, and creates a file which covers those sectors.

TOD gives the day, date and time. I tried it, and it gave the correct answer. By this, I deduced that the 'Unicorn' contained some sort of battery-driven clock. The documentation told me that the clock could be set from the monitor, but did not tell me how.

DDU is a 'disk utility for patching/reviewing disk data'. Unfortunately, the documentation did not tell me *anything* else about this piece of software, and its short description made me think that perhaps it was not the sort of program that should be operated by trial and error.

REMAC is a disassembler, for producing opcodes from a .COM file, so that they can be used with a macro-assembler. **SSUB** is a type of super-submit utility, that allows you to enter a series of commands and have them executed automatically one after the other. **BMAP** produces a disk allocation map.

As software utilities go (and these are given in addition to the usual CP/M utilities) these look not bad — but the fact that not one of them has more than two paragraphs of documentation makes them less than useless.

All in all, the 'Unicorn' *looks* like quite a nice system. Unfortunately, the total lack of decent documentation makes it about as useful as a horse with a horn sticking out of its back . . .

I would like to suggest to SME that they get their act together and, if they expect a serious user (a small business, for example) to buy and use this machine, get some manuals written for it.

And for those of you reading this review — don't buy *any* system until you have seen the final version of the manual, and are happy that you can find all of the information that you want in it. ●

* EDITOR'S NOTE

I contacted Mike Pratt of SME concerning the documentation questions raised by our reviewer. Apparently, SME market this system to 'educated' users — that is, those with an existing technical background in computers, hospitals, colleges, etc. They deliver and install the system, and get it running. In addition, they give the staff who will be using the machine a short training course and don't leave them alone with it until they feel the staff can cope, according to Mike Pratt.

That softens the blow considerably, but this system is definitely not for a 'first time user', as the computer buzz phrase goes. But what happens if those staff leave the organisation?

If there are any technical writers out there with a knowledge of digital and microprocessing systems who can write clear English and explain technical matters in plain language . . . Mike Pratt would like to have a little chat.

R.H.

Time flies on the TRS-80C

Here are two clock programs for the Tandy TRS-80 Color Computer. They take advantage of the colour graphics capabilities built into the Extended BASIC and there's plenty of scope for further development, like adding comments, reminders, etc. In other words — start here and take them as far as you like!

Greg Wilson

YOUR EDITOR asked me to write a program for the TRS-80 Color Computer. Beaut! But I wanted to write an automatic program generator for the 4K machine. Computer-illiterate teachers would be able to create cassette data files without having to throw a switch. The program would throw questions to students and feed the teacher's voice response for the chosen answer and . . . and everything! Your Editor said, "Yeah, fine *but* I want a clock program first".

I had never seen a clock program. I shuddered and quickly turned away from one I saw running in a Sydney shop. (I now wish I hadn't.) No teacher ever taught me about radians, I'll swear.

'Twas a weekend when I started, no one to ask, so I forged ahead (well, groggily staggered) to produce the second listing printed here. A brief burst on that one later, it has a few good points.

I was then told by an acquaintance of mine, Dave Gilbert, an educator not a teacher, that "pi converted theta, as in x coordinate of points, on a circumference is given by sine theta, where theta is the angle in degrees". Back to scratch, but it was a breeze.

Because of the TIMER function of the 80C's Extended BASIC, it will give digital time readouts with just one line in a main program. To use the 80C as a graphic clock is silly unless the graphic program is quick enough to give the computer plenty of time to get on with something useful.

The first listing (CLOCKSUB) does its job in one-twentieth of the real time, so you can GOSUB from line 280 to your own more sensible program. (The second gobbles up a third of the real time. It's pretty, but!) There is plenty of room left on the screen for time updates from your program. You had better brush up on all the DRAW type commands, though. Not the trillion combinations, just the fifty-odd commands. Sorry for writing in Extended BASIC if you haven't got a 16K machine. Complain to your Editor! There are heaps of programs for the 4K machines, anyway.

Program chunks

The action starts at line 200 in 'CLOCKSUB'. Before line 200, arrays are filled for the sixty screen-points reached out to by the minute hand. The hour hand demanded sixty, too. At 140, the graphics of drawing the clock start. That horrible line 200 draws the little flicks at each minute stop and a larger point every five. I prefer brown on beige (140) to the other one that looks like a blueprint. (A shame that the best of the five 80C Invaders uses it.)

You don't like the beige? Change it then. Ignore those librarians who told you that magazines were not to be written on but kept in racks.

The second timing loop (260-300) displays a 4x4 pixel open box (PSET,B) just inside the clock rim. It turns that box off (PRESET) before leaping to the next. The minute-hand loop (230-340) has to work harder, but less often. It goes through the same on and off carry-on (lines 240 and 320, respectively). It also has to PSET (330) the hour hand if it has lobbed on it and rubbed it out when it did a PRESET to itself. The hour hand doesn't use a loop but works on updating (250) the variable H set (220) as minus one. Maybe I just like being able to turn out off-normal time. Read on for why, or skip the fine print.

Fine print

When I began fiddling with micros, memory was valuable so I developed the habit of hoarding variable storage by re-using a variable after it had served its original purpose. Variable 'R' was so easy to remember as a radius (20 & 190), and 'I' (40 & 180) is so generally used for any old loop, that I pulled them off the junk heap to use again.

If there had been only one pair of X-Y (coordinate) arrays, the variables would have been 'X' and 'Y'. The minutes fought the hours for them, and won. The hours pair is 'V' and 'W', which you'll mix up, just as I did. They won 'R' for radius, minutes had to settle for 'S'. 'P' and 'Q' (60) are just to save you typing too many lines (80-110) where it's easy to lose your place. 'CX', the centre X coordinate, is a trifle easier to type than '100'. I hope it will tease you to test different values for 3-D effects — and shocking messes!

The variable 'C' (70) is involved in all that sine-cosine jazz. How can I explain it if I don't understand it? It was easy to work out though. There was no need to worry about sequence for the flicks (200). These work backwards from 29 minutes to 30 minutes. Got it?

The printing, generated by line 120, reassures us that something is happening. The columns give 'C' the minutes, then the X

```
10 REM CLOCKSUB 12/1/82
20 CX=100: R=60: S=80
30 DIM V(59), W(59), X(59), Y(59)
40 FOR I=2TO120 STEP2
50 IF I<62 THEN M=-30 ELSE M=30
60 PI=3.14285714: P=SIN(PI*I/60): Q=COS(PI*I/60)
70 C=60+M-I/2
80 X(C)=INT(CX+S*P+.5)
90 Y(C)=INT(CX+S*Q+.5)
100 V(C)=INT(CX+R*P+.5)
110 W(C)=INT(CX+R*Q+.5)
120 PRINTUSING"## ### ### ### ###": C; X(C); Y(C); V(C); W(C) :REMember not
########...
130 NEXT I
140 PMODE 4,1: PCLS: SCREEN 1,1
150 CIRCLE(CX,100),90,1,1
160 CIRCLE(CX,100),84,1,1
170 PAINT(CX,186),1,1
180 FOR I=2TO120 STEP2
190 IF INT(I/5)<I/5 THEN R=86 ELSE R=90
200 LINE(CX,100)-(CX+R*(SIN(PI*I/60)),CX+R*(COS(PI      *I/60))),PRESET
210 NEXT I
220 H=-1
230 FOR M=0TO59
240 LINE(CX,100)-(X(M),Y(M)),PSET
250 IF M/12=INT(M/12) THEN LINE(CX,100)-(V(ABS(H))  ,W(ABS(H))),PRESET:
: LINE(CX,100)-(V(H),W(H)),PSET
260 FOR S=0TO59
270 LINE(X(S)-2,Y(S)-2)-(X(S)+2,Y(S)+2),PSET,B
280 REM "FOR D=0TO7:NEXTD" to slow
290 LINE(X(S)-2,Y(S)-2)-(X(S)+2,Y(S)+2),PRESET,B
300 NEXT S
310 SOUND 5+M*4,1
320 LINE(CX,100)-(X(M),Y(M)),PRESET
330 IF M=H    THEN    LINE(CX,100)-(V(H),W(H)),PSET340 NEXT M
350 IF H=59 THEN 220 ELSE 230
```

```
10 REM***CLOCKSQR
100 PMODE4,1: PCLS: SCREEN1,0
110 X=8: Y=6: XS=8: YS=6
120 CX=X+15*XS: CY=Y+15*YS
130 LINE(X,Y)-(2*CX-X,2*CY-Y),PSET,B
140 CIRCLE(CX,CY),XS*5,1,YS/XS,1: PAINT(CX,CY),1,1150 X=X+8:Y=Y+8:XS=(30*XS-16
)/30: YS=(30*YS-16)/30
160 XE=X+30*XS: YE=Y+30*YS
170 LINE(X,Y)-(XE,YE),PSET,B: PAINT(X-2,Y-2),1,1
180 BX=INT(X+(CX-X)*.2): BY=INT(Y+(CY-Y)*.2)
190 XM=1.6*XS: YM=1.6*YS: EX=BX+15*XM: EY=BY+15*YM200 O=2*XS:R=2*YS:DIM V(O,R)
210 X1=INT(X+(XE-X)/6): X3=INT((X+5*XE)/5)
220 Y1=INT(Y+(YE-Y)/6): Y3=INT((Y+5*YE)/6)
230 DRAW"C0BM"+STR$(CX-4)+","+STR$(Y-2)+"R3L2U5G1R2BR2R1E1R2F1G3D1R4U1"
231 DRAW"BM"+STR$(X3-5)+","+STR$(Y-2)+"R3L2U5G1"
232 DRAW"BM"+STR$(XE+3)+","+STR$(Y1+2)+"R4L4U2E3H1L2G1"
233 DRAW"BM"+STR$(XE+3)+","+STR$(CY-2)+"E1R2F1G1F1D2G1L2H1"
234 DRAW"BM"+STR$(XE+3)+","+STR$(Y3-1)+"D4R4L2U3D5"
235 DRAW"BM"+STR$(CX+1)+","+STR$(YE+3)+"H1L1G1D3F1R1E1U1H1G1"
236 DRAW"BM"+STR$(X3+2)+","+STR$(YE+2)+"L3D2R2F1D1G1L3"
237 DRAW"BM"+STR$(X1)+","+STR$(YE+2)+"R3D1G3D1"
238 DRAW"BM"+STR$(X-6)+","+STR$(Y3-1)+"R2F1G1L1G1D1F1R1E1U1H1L1H1E1"
239 DRAW"BM"+STR$(X-2)+","+STR$(CY)+"L3H1U1E1R1F1D4G1L1H1"
240 DRAW"BM"+STR$(X-3)+","+STR$(Y1+2)+"H1U4E1F1D4G1BL3U6"
241 DRAW"BM"+STR$(X1-1)+","+STR$(Y-2)+"U5BR4D5"
250 SCREEN1,1: GET(CX-O/2,CY-R/2)-(CX+O/2,CY+R/2),V,G
260 HX=CX-O*2: HY=Y-R: OX=O: OY=0: DRAW"C1BM1,1"
270 PUT(HX,HY+4)-(HX+1,HY+5),V,PSET
280 HX=HX+O: FORS=1TO2: PUT(HX,HY)-(HX+O,HY+R),V,NOT: NEXTS
290 B=1: MY=BY+1: FOR M=0TO7: MX=CX+M*XM: GOTO360
300 B=0: FOR M=1TO15 :MY=BY+M*YM: IFM<>5THEN360ELSE350
310 FOR M=1 TO 15: MX=EX-M*XME 355
320 IF M=8 THEN580 ELSE IFM<>14 THEN360 ELSE350
330 FOR M=1TO15: MY=EY-M*YM: IF M<>11 THEN 360 ELSE 350
340 FOR M=1TO7: MX=BX+M*XM: GOTO360
350 HX=HX+OX: HY=HY+OY
360 SY=Y+1: FORS=1TO15: SX=CX+S*XS: GOTO 410
370 FORS=1TO30: SY=Y+S*YS: GOTO 410
380 FORS=1TO30: SX=XE-S*XS: GOTO 410
390 FORS=1TO30: SY=YE-S*YS: GOTO 410
400 FORS=1TO15: SX=X+S*XS
410 LINE(CX,CY)-(SX,SY),PSET
420 LINE(CX,CY)-(SX,SY),PRESET
430 LINE(CX,CY)-(MX,MY),PSET
440 PUT(HX,HY)-(HX+O,HY+R),V,NOT
450 IF SX>XE-1 THEN SX=SX-1:GOTO 370
460 IF SY>YE-1 THEN SY=SY-1: GOTO 380
470 IF SX<X+1 THEN SX=SX+1: GOTO 390
480 IF SY<Y+1 THEN SY=SY+1: GOTO 400
490 NEXT S
500 SOUND(M+1)*10,1: LINE(CX,CY)-(MX,MY),PRESET
510 IFM=7 AND B=1 THEN 300
520 IFMY>EY-.9 THEN MY=MY-1: HX=HX+OX: HY=HY+OY: GOTO310
530 IF MX<BX+.9 THEN MX=MX+1: GOTO330
540 IF MY<BY+.9 THEN MY=MY+1: GOTO 340
550 NEXTM
560 PUT(HX,HY)-(HX+O,HR+R),V,PSET
570 HX=HX+OX: HY=HY+OY: GOTO290
```

and Y coordinates of the minutes, and the equivalents for the hours. The hour hand jumps a minute section for every twelve jumps of the minute hand.

We need sixty flicks, or minutes. You can think of them as 1-60 or 0-59. Think 0-59, else you will start at one minute after one rather than noon, midnight or 12 o'clock. Luckily, computers think the same way. When told to DIM X(59), room is made for an array of sixty, 0-59. Because zero divided by any number ends up as zero, at start, the line 250 test will be met and 'H' incremented. We want 'H' to be zero after that addition of one (250). Line 230 wastes too much time sounding a rising tone.

If you want a stop watch, drop it.

Use an INKEY$ line to start. In the same way, it's not hard to INKEY$ a start time. Make up your own mind to drop it or expand it to give tones of longer duration for the minutes. You won't have to look at the clock face after a few weeks. Your body clock will do the conversion of tones to time for you. You'll likely be in a padded cell, so you may as well keep time as do anything else!

Square clock

The second listing, 'CLOCKSQR', doesn't give a square clock, it gives a rectangular one. It fills the screen. BUT you can easily change X-Y in line 110 to give you a new top left-hand corner. If YS is greater than XS, you'll get a tall skinny grandfather clock. What will happen if you use the same number for YS as for XS? Reduce XS-YS and you can get a small face, leaving you plenty of room for update information.

The face has an oval centre that I think is pretty. Well it looks like antique lace, if you go for that. If you don't, how about the same second hand that draws the lace, tucking out a tiny diagonal of the rim? I reckon that it gives the frame a 3-D effect.

I've looked at that frame so long in testing the program, I suppose I could see anything in it. That frame contains very costly (230-241) numbers. Work out where to place them and you can use them in the first program. It would have been simple to wed hour hands to the second and minute ones. I didn't because I'm a Smart Aleck. Instead, a large blinking block moves around the frame, taking four steps each hour. Work out why the block doesn't erase the numerals when it lands on and moves off them. Instead, they blink too. You can fool the 80C just as easily as any other computer.

I won't waste valuable paper going on about how it works. It's not a trim program. The 6809 in the 80C really moves, even at the normal speed. It's hard not to become sloppy, it loves being kept busy. By the way, if your 80C will run at double speed, forget that stuff about one-twentieth and one-third. Halve them.

Keying-in

If you have a Master Control program, getting the programs into the 80C won't be too hard. Debugging to find your typing errors will give you the feel of some of the graphics commands. The Microsoft Editor built into the Extended BASIC is a dream for program editing; fixing those errors will be a pleasure. ●

660 SOFTWARE

CHARACTER GENERATOR AND VIDEO MESSAGE MAKER

Frank Rees, 27 King St, Boort Vic. 3537

Here is a subroutine to generate characters and numerals. Two small programs are also presented, one allowing you to display the complete character set generated, the other allowing you to write messages on screen by typing in an appropriate set of 'tokens' or codes for each character required. Combine this with your own programs and you've got a powerful message generator.

The first thing you should do is enter the CHARACTER GENERATOR ROUTINE FROM 073C. Then, you can do one of two things: to examine the complete character set, enter the DISPLAY CHARACTER SET program and run; or enter the VIDEO MESSAGE MAKER program and run.

With the video message maker, a flashing cursor will appear at the top left hand corner of the screen. Think of a word or simple message to type on screen, say 'ETI'. Look at the character code table and work out the codes for each letter. E = 0E, T = 1D, I = 12. The first figure of the code serves two purposes. Press key 0 twice. The first press will cause the cursor to disappear, the second time you press it, the computer will beep at you signifying you've entered the first half of the character code or token. Then press key E and the letter E will appear at the top left hand corner of the screen. The cursor will then appear at the next location on the screen. Then press key 1 twice. At the first press the cursor will disappear, at the second press the computer will beep and the letter T appear on the screen. The cursor will reappear in the next location. Then press: 1 — 1 — 2 and I will appear. Voila — ETI!

When the cursor is on screen, you can move it about by pressing C. A single press will shift the cursor along one character space. If you hold the key down it will move along the spaces from left to right. When it reaches the end of a line it will jump to the start of the next line. Upon reaching the end of the screen it will return to the top left hand corner and start again. Using the cursor, you can position your message where you like on the screen.

You can write up to sixteen characters on a line and you get four lines on the screen.

Back-spacing is done with the D key.

To correct an error, move the cursor over the incorrect character and type the token for the correct character. To erase a character, move the cursor into place and enter the code for the cursor. Move the cursor and the character will disappear.

The characters are generated using the method described in "Hints for CHIP 8 programmers, part 1" in ETI December 1982, page 110 under the heading of 'Captions-to-screen movers'. Sixteen consecutive bits of data (two bytes) are moved into view on screen in a 3 x 5 matrix, making up the characters. This is very economical of memory space as it uses the least amount of data storage. Diagram 1 shows the general arrangement of the bytes and how the bits are positioned on screen in the 3 x 5 matrix. Note that the least significant bit (LSB) of byte 2 is not used. The most significant bit (MSB) of byte 1 appears in the top left hand corner of the matrix.

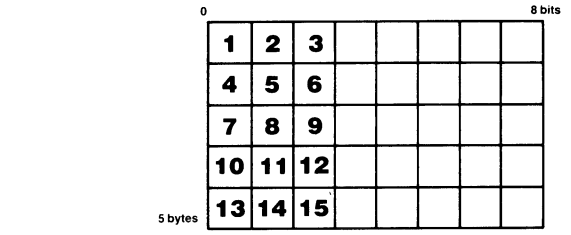
To display a character on screen, the data is shifted from its location in memory (07C6-7) to locations 07F4-5-6-7-8. Then, using the AMMM and DXYN instructions, this is shifted into position on screen, stacking the five bytes down the screen. Diagram 2 shows how it happens when you enter the code for the letter P.

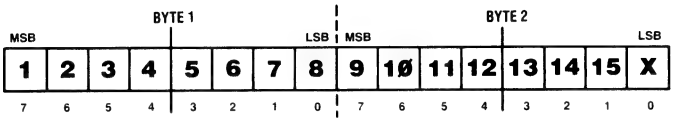
C = cursor D = back space

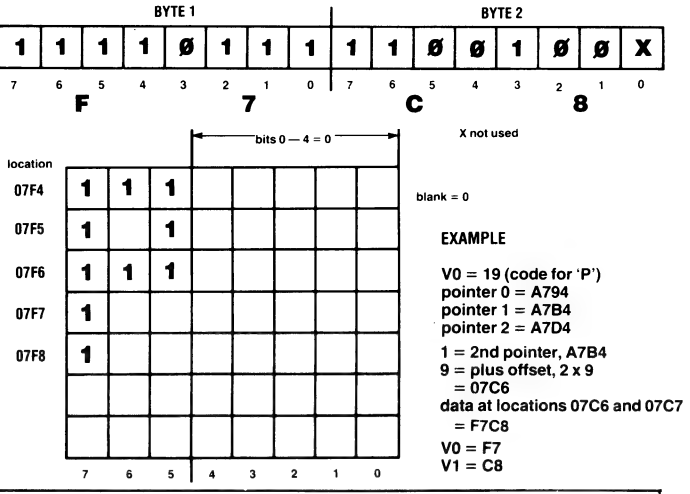
CHIP 8 CHARACTER GENERATOR character code table

X	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
code																
0X	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1X	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
2X	W	X	Y	Z	?	<	>	.	+	−	x	/	■	=	'	!

X must be a hex number from 0 to F. e.g: a code of 28 gives +; 08 gives 8;
2 C is the cursor.







EXAMPLE

V0 = 19 (code for 'P')
pointer 0 = A794
pointer 1 = A7B4
pointer 2 = A7D4
1 = 2nd pointer, A7B4
9 = plus offset, 2 x 9 = 07C6
data at locations 07C6 and 07C7 = F7C8
V0 = F7
V1 = C8

```
VIDEO MESSAGE MAKER
0600  1602  go to 0602
      6700  V7 = 00
      6801  V8 = 01
      6902  V9 = 02
      6C0C  VC = 0C
      6D0D  VD = 0D
      6A00  VA = 00
      6B00  VB = 00
0610  602C  V0 = 2C
      273C  do subroutine 073C
      DAB5  show N @ VX,VY
      273C  do subroutine 073C
      DAB5  show N @ VX,VY
      ECA1  skip if VC ≠ key
      7A04  VA = VA + 4
      EDA1  skip if VD ≠ key
0620  7AFC  VA = VA - 4
      3A40  skip if VA = 40
      162E  go to 062E
      6A00  VA = 00
      7B06  VB = VB + 6
      4B2A  skip if VB ≠ 2A
      160E  go to 060E
      E7A1  skip if V7 ≠ key
0630  163C  go to 063C
      E8A1  skip if V8 ≠ key
      163C  go to 063C
      E9A1  skip if V9 ≠ key
      163C  go to 063C
      1610  go to 0610
      F00A  V0 = key
      8004  V0 = V0 + V0
0640  8004  V0 = V0 + V0
      8004  V0 = V0 + V0
      8004  V0 = V0 + V0
      F10A  V1 = key
      8014  V0 = V0 + V1
      273C  do subroutine 073C
      DAB5  show N @ VX,VY
      7A04  VA = VA + 4
0650  1610  go to 0610
(character generator to be entered
from 073C)

CHARACTER GENERATOR
073C  A7FA  I = 07FA
      F555  MI = V0:V5
0740  630F  V3 = 0F
      8302  V3 = V3 AND V0
      64F0  V4 = F0
      8402  V4 = V4 AND V0
      A794  I = 0794
      4410  skip if V4 = 10
      A7B4  I = 07B4
      4420  skip if V4 = 20
0750  A7D4  I = 07D4
      8334  V3 = V3 + V3
      F31E  I = I + V3
      F165  V0:V1 = MI
      A7F4  I = 07F4
      8200  V2 = V0
      8310  V3 = V1
      64E0  V4 = E0
0760  6580  V5 = 80
      278E  do subroutine 078E
      8020  V0 = V2
      2788  do subroutine 0788
      8020  V0 = V2
      8004  V0 = V0 + V0
      8152  V1 = V1 AND V5
      3100  skip if V1 = 00
0770  7001  V0 = V0 + 1
      2784  do subroutine 0784
      8030  V0 = V3
      278C  do subroutine 078C
      8030  V0 = V3
      2786  do subroutine 0786
      A7FA  I = 07FA
      F565  V0:V5 = MI
0780  A7F4  I = 07F4
      00EE  return
      8004  V0 = V0 + V0
      8004   "   "
      8004   "   "
      8004   "   "
      8042  V0 = V0 AND V2
0790  F055  MI = V0
      00EE  return
      F6DF  0     #character data
      4925  1      starts here
      E7CF  2
      E79F  3
      96F3  4
      F39F  5
07A0  F3DF  6
      E493  7
      F7DF  8
      F79F  9
      F7DB  A
      D7DD  B
      F24F  C
      D6DD  D
07B0  F3CF  E
      F349  F
      F2DF  G
      B7DA  H
      E92E  I
      24DF  J
      B75A  K
      924F  L
07C0  BFDA  M
      F6DA  N
      F6DF  O
      F7C8  P
      F6F4  Q
      F7EB  R
      711D  S
      E925  T
07D0  B6DE  U
      B6D5  V
      B7FA  W
      B55A  X
      B7A5  Y
      E54F  Z
      E789  ?
      2A22  <
07E0  88A8  >
      0003  .
      0BA0  +
      0380  -
      1550  x
      0540  /
      FFFF  cursor
      1C70  =
07F0  9000  '
      4905  !  #character data ends
      4040  store for 5 display bytes
      4000
      4000
      2F80  store for 6 progr. variables
      0BA0
      E080
(note: 07F4 - 07FF can be anything)

DISPLAY CHARACTER SET
0600  1602 6000 6B06 6A00 160A 273C DAB5
      7001
0610  7A04 3A40 1608 7B06 3B18 1606 F00A
      00E0
0620  1602
then enter Character Generator from 073C.
```

THIS MONTH is a potpourri of contributions from readers ('Bee owners all) on a wide variety of topics covering software and hardware.

For those who had difficulty with Tom Moffat's 'Bee-O-Rhythms' printout in the January issue, he's now got a proper printer (the Model 15 teletype has been pensioned off ...) and a better printout is reproduced here. Let's get on with a few hints and tips, then.

INTEGER ACCURACY

Andrew Allan, Manly Vale NSW

Be careful of the effect of accuracy of functions when working with integers in mixed mode. Here's a good illustration. The following small program was intended to print a natural binary series — but, boy, did it go wrong!

```
FOR N=1 TO 10:Q=INT(2↑FLT(N)):LPRINT ,,,Q:NEXT N:END
                2
                3
                8
                16
                32
                64
                128
                256
                512
                1024
```

That 3 is not what you want. The problem is due to a change in sign of the error in the operator for raising a real to a power. Take a look at this:

```
FOR N=1 TO 10:Q1=2↑FLT(N):LPRINT ,,,Q1:NEXT N:END
                2.0000003
                3.9999968
                8.0000145
                16.000018
                32.000007
                64.000084
                128.00014
                256.00041
                512.00058
                1024.0021
```

The solution is to always use a bias to offset things as INT rounds down. Do it like this:

```
FOR N=1 TO 10:Q=INT(0.01+2↑FLT(N)):LPRINT ,,,Q:NEXT N:END
                2
                4
                8
                16
                32
                64
                128
                256
                512
                1024
```

CASSETTE BACKUP

Michael Alexander, Balaclava NSW

Here is a short routine that enables you to make backup cassette program copies. Note that, if you're doing this with a program purchased on tape, then the backup should be for your personal use only — resale of a copy or copies is a *breach of the Commonwealth Copyright Act,* which is now a *criminal offence.* You have been warned.

It is obvious that the easiest way to make a copy or backup tape is to simply use two recorders and dub from one to the other. This approach is sort of OK, but reliability can suffer because of the signal shaping circuitry in cassette recorders. They are not designed to handle square waves efficiently.

The approach I used was to employ two recorders still, but send the signal from one recorder to the other via the computer to square up the signal before recording. The routine below is written in BASIC for ease of use but the program only serves to enter a machine language subroutine.

To use it, first play the tape into the computer to check that it will load. While you're doing it, time how long it takes. If it loads OK, get rid of it and then load the program shown below. Type RUN and connect the lead which usually goes to the cassette earphone to the earphone output of the cassette player in which you are playing the tape. The other cassette lead goes to the microphone input of the recorder making the backup tape.

```
00100 REM Biorythm program by Tom Moffat; 5,9,82
00110 REM To be used with or without printer.
00120 DIM T(12),S1(52)
00130 FN0=(SIN(FRACT(A1/#)*6.28)+1)*25+3
00140 CLS: INPUT "What is your name? ",N1$
00150 INPUT "Do you want a description? (Y or N)",K1$
00160 IF K1$="n" OR K1$="N" THEN 340
00170 CLS: PRINT "     Well, ";N1$;", now is your chance to see if you"
00180 PRINT "will prosper or wither, live or die. The theory of BIORYTHM"
00190 PRINT "states that life exists in three cycles, all starting at birth."
00200 PRINT "     The PHYSICAL cycle has a period of 23 days, the EMOTIONAL"
00210 PRINT "cycle is 28 days, and the INTELLECTUAL cycle is 13 days,"
00220 PRINT "     When a cycle is UP the function is operating at peak"
00230 PRINT "efficiency; when it is DOWN the function is resting, storing"
00240 PRINT "energy for the next UP phase. At the zero crossing the"
00250 PRINT "cycle is said to be CRITICAL, a time when caution is"
00260 PRINT "indicated. When two cycles coincide at CRITICAL the day is"
00270 PRINT "said to be 'double-critical'. When all three coincide at"
00280 PRINT "CRITICAL the day will be a total disaster."
00290 PRINT "     Now, "N1$", you may say this whole concept is a"
00300 PRINT "load of old codswallop. If so, press BREAK to exit the program."
00310 PRINT "But if you're game, press any other key to continue."
00320 K1$=KEY$
00330 IF K1$="" THEN 320
00340 CLS
00350 INPUT "PLEASE ENTER YOUR BIRTHDAY (DD,MM,YY):" D,M,Y
00360 GOSUB 790
00370 A=Z
00380 INPUT "WHEN DO YOU WANT YOUR CHART TO BEGIN (DD,MM,YY)?" D,M,Y
00390 GOSUB 790
00400 A=Z-A
00410 INPUT "AND FOR HOW MANY DAYS?";L
00420 DATA 31,28,31,30,31,30,31,31,30,31,30,31
00430 FOR I=1 TO 12
00440 READ T(I)
00450 NEXT I
00460 OUT#5 ON
00470 CLS
00480 PRINT TAB (10);"*** PERSONAL BIORYTHM CHART FOR ";N1$;" ***"
00490 PRINT TAB (10);"Physical = P; Emotional = E; Intellectual = I"
00500 PRINT
00510 PRINT " ";"DATE";
00520 PRINT TAB (13) "DOWN";
00530 PRINT TAB (35) "CRITICAL";
00540 PRINT TAB (62) "UP"
00550 PRINT " ";[A62 45]
00560 A1= FLT(A)
00570 P=INT(FN0(23))
00580 E=INT(FN0(28))
00590 I=INT(FN0(33))
00600 FOR X=0 TO 52
00610 S1$(X)=" "
00620 NEXT X
00630 S1$(28)="."
00640 S1$(P)="P"
00650 S1$(E)="E"
00660 S1$(I)="I"
00670 PRINT STR(D); STR(M); STR(Y); TAB(10);
00680 FOR X=0 TO 51
00690 PRINT S1$(X);
00700 NEXT X
00710 PRINT S1$(52)
00720 IF L=1 THEN OUT#5 OFF: END
00730 L=L-1
00740 A=A+1
00750 D=D+1
00760 IF M=2 AND D=29 AND Y=(Y/4)*4 THEN 560
00770 IF D<=T(M) THEN 560 ELSE LET M=M+1: D=1
00780 IF M<=12 THEN 560 ELSE LET M=1: Y=Y+1: GOTO 560
00790 M1=FLT(M): Y1=FLT(Y)
00800 Z=INT(30.57*M1)+INT(365.25*Y1-32537.25)+D
00810 IF M<3 THEN RETURN
00820 IF Y=(Y/4)*4 THEN LET Z=Z-1 ELSE LET Z=Z-2
00830 RETURN
```

Play the original tape into the computer and simultaneously record it with the other recorder. Having already timed how long it takes, let it run the required time plus a few seconds more to be on the safe side.

Having made your backup, load it into the computer in the usual way to test it.

The backup copy is always of inferior quality to the original, you'll find. Always use the backup and put the original in a safe place. If the backup fails for one reason or another, just make another copy from the original.

The program will work on all tapes, even machine language ones.

THE 64K+ AND ETI-668 EPROM PROGRAMMER

Geoff Nicholls, ETI

If you have the 64K+ MicroBee, like we do, and want to use the ETI-668 EPROM Programmer project with it (February '83 issue), then you'll need to make a small modification to the software. The 64K+ has the monitor residing from E000 hex, so here's what you do:

- change location 0E32 to E0 (was 80)
- change location 0F03 to E0 (was 80)
- change location 0EAB to 76 (was 09). ●

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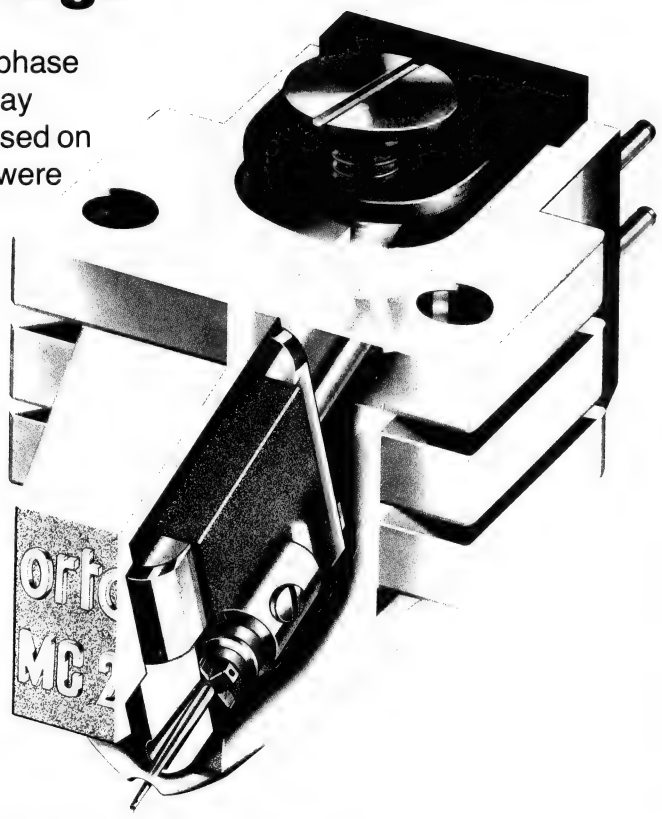
Ortofon MC 2000 cartridge

Ortofon claim that the MC 2000 is the world's first ortophase cartridge. The ortophase concept is the optimal interplay between amplitude response and phase response, based on tests which showed that the best sounding cartridges were actually those that had a practically linear phase response together with a frequency response that showed a rise of approximately 2 dB at 20 kHz.



The output voltage of this moving coil cartridge at 1 kHz, 5 cm/s is 0.05 mV. At 1 kHz the channel balance is less than 1 dB and the channel separation is better than 25 dB. The channel separation at 20 kHz is greater than 18 dB.

The frequency range is 5 Hz to 90 kHz and the amplitude response is 5 Hz to 50 kHz, from 5 dB to 1 dB.

The FIM distortion is less than 1% and the tracking ability at 315 Hz, at the recommended tracking force, is better than 100 um.

The MC 2000 stylus is a symmetrical contact line diamond with a recommended tracking force of 15 mN/1.5 g.

The equivalent stylus tip mass is 0.27 mg which is achieved by using a light aluminium cantilever of conical shape, a tiny diamond and a very small cross-shaped aluminium armature. The legs of the cross are hollow, reducing the mass by 66% in comparison to traditional armature designs.

The magnesium headshell which was designed for the MC 2000 has a standard Ortofon/ SME plug.

Cut the static in your car radio/cassette player

Noise generated by a vehicle's ignition and other electrical components can ruin your enjoyment of a program on your car radio or tape playing in your cassette player.

Benelec Pty Ltd offer a range of vehicle noise suppressors that can restore peace and quiet to your car radio/cassette player.

Although your vehicle may be fitted with ignition 'suppressor' leads, ignition noises can be conducted along the 12 V battery cables and into your radio/cassette player via its power lead.

Benelec's 'hot line' noise suppressor kit, catalogue no. 11-105, will get rid of that source of noise, in most cases, when inserted in the car radio/cassette player's power lead.

To get rid of persistant noise from your vehicle's alternator/ generator, Benelec has no less than four suppressors to tackle the problem.

For cars fitted with alternators, you can choose from the 11-101, a light duty type, the 11-102, a heavy duty type (for vehicles with batteries from six to 32 volts) and the extra heavy duty type, rated to carry 100 amps, the 11-104.

The 11-103 is a 'tunable' generator filter, rated to carry 25 amps, and is especially suited for suppressing generator whine in CB rigs and HF transceivers.

A feedthrough noise suppressor to get rid of the last vestiges of annoying alternator/generator whine and regulator clicks and plops is also available, catalogue no. 11-110.

Full details can be obtained from **Benelec Pty Ltd, P.O. Box 21, Bondi Beach NSW 2026. (02)665-8211.**

RCA plans to release CED Disc System soon in Europe

For the initial launch of its CED Video Disc System RCA will be supplying discs from its disc manufacturing plant in Indianapolis USA.

According to Jay Brandinger, vice-president and general manager of RCA SelectaVision Video Discs operations, "The hardware and software facilities are ready for mass production while marketing and distribution matters are in current negotiations".

European CED players are expected to be offered by a number of brands presently doing business in Europe. Demonstrations have been given showing the compatibility of CED discs with both the PAL and SECAM television systems.

Dr. Brandinger said that while the disc size is the same for both the NTSC and European systems, the latter employs a slower rotational speed of 375 rpm and 50 Hz frequency, compared with 450 rpm and 60 Hz in NTSC countries. The CED European players feature visual scanning, forward and reverse at four times, 16 times and 120 times normal speed, random search and pause, stereo sound and two-channel bilingual sound.

New address for Dynaudio

Dynaudio (Aust) Pty Ltd have transferred their facilities to 274 Victoria St, Brunswick Vic. 3056. (03)387-6170. Tlx AA38348.

They are appointing new dealer outlets throughout Australia and have released two new fully imported models of loudspeakers, the DA100 and DA200. ▶

Why
Direct

Don't tangle with Technics.

The majority of audio systems – even the most beautifully designed – have something ugly to hide.

It's that mass of jumbled-up connecting leads that you find, all too easily, at the rear of the equipment. Not only are they ugly, they're inconvenient, too.

And as audio components become smaller, the problem becomes bigger and more unsightly.

To solve this problem, Technics developed their Direct Connector systems, which eliminate all audio connecting leads between the tuner, amplifier, graphic equalizer and cassette deck.

Each of these components features a special flip-up connector to allow them to be literally plugged in to each other!

It's an elegant piece of Technics technology that results in a stylish, neat installation that can be put together or taken down for re-location in a matter of seconds.

The 315 Series.

But Direct Connector capability is not the only innovative feature in this new and compact series from Technics.

The SL-5 direct-drive, linear-tracking turntable employs its own plug-in connector system for the pickup cartridge.

This unique Technics development has been adopted as a World Standard.

It means you can compare and evaluate cartridges from leading manufacturers like Audio Technica, Ortofon, Shure, Stanton, Empire, Pickering, ADC and, of course, Technics without conventional setting up procedures.

Technics developed Connector systems.

No adjustment of tracking weight or bias correction is needed.

The innovations continue in the rest of the components: the SU-5 amplifier includes a Super Bass switch to enhance the bass response of a speaker system without inducing bass boom; the ST-5 quartz synthesizer digital tuner provides random access memory for 16 pre-set stations; the SH-E5 graphic equalizer – offers adjustment of 12 audio bands from 16Hz to 32Hz on each channel; whilst the RS-5 cassette deck – has soft touch controls, auto selection of metal, CrO_2 and normal tape settings plus convenient Cue and Review functions.

Finally, a pair of SB-F5 speakers with horn-type tweeters and bass reflex porting turn the high quality electrical signals of the rest of the system into the high quality sound you expect.

Compact components, full-size warranty.

All components in this series are perfectly matched in styling and performance.

And all are covered by a full 2-year warranty backed by Technics' reputation. Visit your Technics stockist soon and experience the superb styling and brilliant sound of Technics' compact Series 315 for yourself.

Technics 2 Two Year Warranty

Technics

National Panasonic (Australia) Pty Ltd

Expanding the music experience.

Dailey/NPA181R

Sony chairman awarded the Albert medal

Akio Morita, Chairman and Chief Executive Officer of Sony Corporation, has been awarded the Royal Society of Arts 1982 Albert Medal.

He received the medal from HRH The Duke of Edinburgh, President of the Royal Society of Arts, for his "Outstanding contributions to technological and industrial innovation and management, industrial design, the development of recording and video systems and the growth of world trade relations".

This is the first time that a person from outside Europe or America has received an Albert medal.

Sony established Sony (UK) Ltd in 1968, as a wholly-owned subsidiary. In 1980 Sony (UK) received the Queen's Award for export excellence.

Computerised microphone discussion systems

The International Congress Service, Microphone Discussion System (Digimic Mini) consists of a standard 19 inch central control unit, operator's console, delegate discussion microphone desk stand and microphone with built-in loudspeaker.

The built-in loudspeaker allows decentralised sound reinforcement, without the need of large loudspeakers or sound columns, which may cause feedback or echoes. The electret microphone is insensitive to mechanical vibrations and electromagnetic interference.

The individual microphones are centrally controlled by a microprocessor according to the programmable mode of operation which may be selected on the operator's console.

The Digimic Mini uses single cable technology and has the capacity for 63 microphones.

The system is available for sales or rental from **R.H. Cunningham Pty Ltd, 146 Roden St, West Melbourne Vic. 3003. (03)329-9633.**

Pioneer develops 'still pictures with sound' for videodisc

Pioneer Electronics has developed the technology to add sound to still pictures on its laser optical video disc.

The principle of the 'Still Picture with Sound' system (SWS) involves the compression of soundwaves using a special technique, before they are digitised and recorded on the portion of the disc where picture images would have been recorded.

A still picture associated with the sound is then recorded on the next portion, allowing a still picture with approximately 13 seconds of accompanying sound to be played back.

The standard 30 cm videodisc currently available on the market is capable of storing 54 000 still pictures without sound and will run for about 20 hours. But this will be extended to 50 hours or longer if the clarity of sounds are restricted to the level of telephone quality.

Pioneer plans to introduce the SWS system into the business use market within two or three years for training and education. The disc edited for SWS can be played back with the addition of an adaptor to the current player model.

Pioneer now has four Laserdisc models available, including the LD-600 which is used exclusively for movies and music programmes.

Laserdisc was introduced into the European market late in 1982 at a cost of approximately $900.

It is expected that Europe will follow the American and Japanese example by using videodiscs as 'records that reproduce pictures', while also taking advantage of features such as random access which enables instantaneous search for a desired picture and the function to view a still picture for a long time.

20 cm (8") discs, which will enable soft disc makers to meet the needs for less expensive software, will soon be introduced to complement the 30 cm discs currently available. The new discs will be used primarily in the domestic market.

Pioneer is now manufacturing laser videodiscs in a fully-automated factory in Japan. By the middle of 1983 there will be a Pioneer disc pressing plant in California US.

Commercial use of the system is expected to be boosted by the Pioneer Videodisc interface IF 1000 which can be used to connect the Laserdisc system with a personal computer.

This interface will increase the ways in which the Laserdisc can be used with personal computers by allowing the picture and sound of Laserdisc to be programmed freely with the personal computer.

The interface part can be connected to almost any printer board of a personal computer and, by using the display switching function, one monitor can be used for both the personal computer and the Laserdisc.

For more information contact **Mr. Ron Ward, Pioneer Electronics Australia Pty Ltd, 178 Boundary Rd, Braeside Vic. 3195. (03)580-9911.**

National's new range of video equipment

National has predicted that in 1983 the demand for portable video cassette recorders and cameras will double that of 1982.

Their new range of portable video equipment and accessories includes the NV-100A lightweight portable VTR which is one third smaller and is almost 40% lighter than previous models. It features cue and review (x9 speed), insert edit, slow motion playback and up to two hours portable recording.

The NVV-10A compatible delux tuner timer features 14 day 4 programme timer, 16 function cordless remote control, auto search tuning for up to 16 different channels and one touch timer recording.

The WVP-50N hand held colour camera weighs 1.7 kg and features auto-focus through an ultra sonic system, advanced picture quality for high resolution, electronic viewfinder, automatic audio video fade in and fade out and automatic white balance.

The WVP-100N shoulder mount camera has all the features of the WVP-50N plus a special character display facility which allows recording of the filming date, tape counter and memory function, stop watch and camera function check and battery charge level indication.

The WVP-30N hand held colour camera weighs only 1.5 kg and has an electronic viewfinder and one touch slide zoom.

Accessories for the WVP-100N are a remote controller for the camera and the recorder, film slide adaptor and zoom lens.

More information can be obtained from National Panasonic (Aust) Pty Ltd, 95-99 Epping Rd, North Ryde NSW 2113. (02)887-5333.

AM stereo broadcasting under way in the US

Station KTSA in San Antonio began stereo broadcasts on the AM band (540-1630 kHz) late in July last year, followed by some 25 other stations in the latter half of 1982.

Many of the new stereo stations employ the 'Kahn system' of modulation where the carrier is phase-modulated with L-R signal and then amplitude modulated with the L+R signal. Sophisticated circuitry produces the broadcast signal which has the left channel on one sideband and the right channel on the other. The system has the advantage that, when tuned on an ordinary receiver, it demodulates the signal as R+L, and the listener is unaware that the station is transmitting a different signal.

Stereo reception of the Kahn system requires the receiver to have phase detection as well as AM envelope detection to separate the two channels. (For more information, see ETI, July 1977, pages 12-13.)

Pioneer unveils digital audio disc player

At the Brisbane Home and Outdoor Exhibition Pioneer took the wraps off their digital audio disc player and discs which will eventually replace the conventional turntable and long playing records.

With the Pioneer Digital Audio Disc, the recorded information is encapsulated in a transparent protective coating that is fully accessible to the laser beam optical pick-up. Each 120 mm diameter disc contains over five billion digital sound signals which are laid out in a helical track and are scanned from the centre outwards.

The digital technique provides many significant performance advantages over the conventional audio system. There is no rumble, wow or flutter with a flat frequency response between 5 to 20 kHz.

There is negligible noise or distortion with a dynamic range of 90 dB. Channel separation is over 90 dB against 30 dB for a good conventional record player and there is no sound colouration.

As there is no disc contact with the laser pick-up the skip, index scan, repeat and search functions are very fast.

The digitally recorded information is sealed inside the disc within the transparent plastic coating so it is safe from dust, scratches and fingermarks.

Major record companies in Europe, the United Kingdom and Japan are currently pressing new titles in the digital audio disc format for a progressive worldwide launch this year.

Pioneer expects to launch the digital audio disc and player in Australia sometime this year at a cost of approximately $750 per player. Discs will be available through conventional record outlets at approximately $15 each.

For further information contact **Mr. Ron Ward, Pioneer Electronics Australia Pty Ltd, 178 Boundary Rd, Braeside Vic. 3195. (03)580-9911.**

Video cassette recorder manufacturers warn retailers

Evidence of possible infringements of Section 52 of the Trade Practices Act has prompted manufacturers of Beta format video cassette recorders to issue a warning to retailers.

Indications suggest the Beta format manufacturers are totally disenchanted with the dishonest attitude being demonstrated by some video retailers who are making deliberately misleading statements to prospective VCR purchasers regarding the different video formats.

Beta manuafacturers have undertaken an Australia wide survey of video dealers and prerecorded video software resellers in an attempt to determine which retailers are contravening Section 52 of the Trade Practices Act.

A spokesman for the group, Managing Director of Toshiba (Aust) Pty Ltd said, "Sufficient information in the form of signed statements by the principals of the companies manufacturing Beta format machines has been printed and published to ensure that no doubt exists in the minds of the retailers of Australia as to the future of the Beta format".

For more information contact **Mr. T. Thacker, c/o Toshiba (Aust) Pty Ltd. (02)887-3322.** ▶

ARE YOU MISSING OUT?

You've spent hundreds or maybe thousands of dollars on your hi-fi. Great amplifier, superb turntable, fantastic speakers. But are you getting all the sound you paid for?

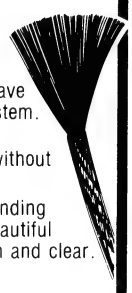
Probably not . . . if the vital connections between your hi-fi components aren't made using the Monster Cable system of precision cables, connectors and accessories.

Monster Cable is a proven interconnect system that will dramatically increase audio performance and provide the best acoustic value-for-money improvement you're ever likely to make to your hi-fi.

If you're really serious about your sound system and the listening pleasure you derive from it . . . read on!

MONSTER CABLE

AUSTRALIA'S LARGEST SELLING SPEAKER WIRE SYSTEM



The rapid improvements in power amplifiers and loudspeakers have focused attention on a major weakness — the speaker cable system.

By eliminating the problems associated with conventional wire, Monster Cable directly couples your amplifier to your speakers without loss, without distortion.

How? More copper, finer strands, higher purity and a unique winding configuration that lets your amplifier and your speakers make beautiful music together. For sounds that are dynamic and powerful, open and clear. The way real music should be.

And more! Monster Cable provides big performance for little dollars. You can significantly improve the performance of your sound system simply by switching from your conventional speaker wire to Monster Cable — it costs you less than buying better speakers, a better amplifier, or even a better cartridge.

However . . . beware the imitators. They offer price but not quality. Only the finest materials are used in producing Monster Cable. And it is safe to use with all amplifiers, regardless of design.

Monster Cable is available conveniently pre-packed in 3.7 metre (12 ft), 6.1 metre (20 ft) and 9.1 metre (30 ft) pairs, or can be professionally cut and terminated in custom lengths at your local Monster Cable dealer.

PERFORMANCE STANDARD SERIES

INTERLINK/PHONOLINK

Designed specifically for transmitting low level audio signals, Interlink sets a new standard of performance and value in interconnect cables — for turntables, pre-amplifiers, tuners and tape decks. (And video equipment as well.)

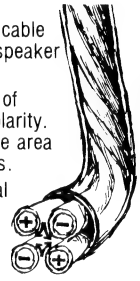
Interlink features a special ULTRA LITZ conductor — over 100 separately insulated strands of high purity copper. This inner core allows the most accurate signal transfer without high frequency loss.

Monster Cable has also developed and produced the perfect termination for Interlink cable — Phonolink, a precision gold-plated RCA-type plug. Phonolink features a split centre shaft for increased contact pressure and materials that reduce interference with the audio signal to an absolute minimum.

Sonically, Interlink/Phonolink combine to maximise your sound system's performance for increased clarity, greater dynamic range, lower distortion and reduced hum and RF interference.

Interlink/Phonolink is available in pre-packaged 1 metre pairs or can be cut and terminated to the exact length you require by your Performance Standard Series dealer.

POWERLINE



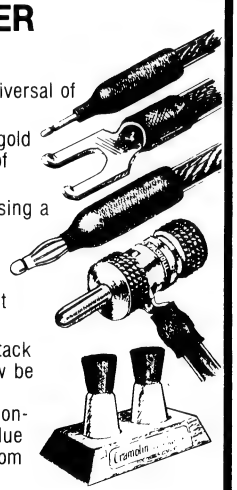
Powerline is a four conductor, controlled impedance speaker cable that has been designed as the ultimate link in the amplifier-speaker interface.

Based on the high purity, fine copper stranding construction of Monster Cable, Powerline utilizes two conductors for each polarity. This results in extremely low resistance and a greater surface area of conductivity for maximum power transfer at all frequencies.

Sonically, Powerline brings you one step closer to the musical event. Startling clarity in the highs, tight well-articulated bass, dynamic impact and the precise localisation of instruments within the sound stage enhance your aural experience.

Powerline is available in custom cut and terminated lengths from your local stockist. He'll also be able to demonstrate the advantages provided by this new technology, which make Powerline a lifetime investment in your listening pleasure.

AND WHATEVER THE CONNECTION . . . MONSTER CABLE CAN MAKE IT



Gold Pin. The smallest and perhaps the most universal of our amplifier- to-speaker connectors.

Gold Spades. Beautiful construction with hard gold surfaces to make the ideal connection with many of today's amplifiers and speakers.

Gold Banana. An elegantly simple connector, using a crimp-on design with multiple fingers, that can significantly reduce contact distortion.

X-Terminator. An expanding solid shaft tip provides both greater contact area and high contact pressure — the ultimate banana-type connector.

Cramolin. Oxidation and contamination, which attack every connection point in an audio system, can now be corrected and prevented.

Cramolin Red solution removes distortion-producing oxides and corrosions, while Cramolin Blue solution preserves and protects cleaned contacts from any further deterioration.

The Monster Cable interconnect systems and accessories are available at all leading hi-fi stores. Happy listening from all of us at Monster Cable.

Get all the sound you paid for...

MONSTER CABLE

Distributed by Convoy Sydney (02) 698 7300

RG/C1594

Sony Betamovie: top secret

Sony has made an unofficial announcement about a new product called Betamovie but details of its specifications are classified information until it is due to be launched.

Betamovie is a combined camera/recorder using standard half inch Beta tape. It is a record only machine. It has no playback facilities but a tape recorded with Betamovie can be played on a conventional Beta VCR.

Betamovie is not a 8 mm video as it has been derived from a totally different concept. And it is not the same as Betacam which is for professional usage.

It will be approximately half the size of the SL-F1E video recorder, weigh about 2.5 kg and have a recording time of 3.25 hours with L-750 tape.

Betamovie is a PAL system and will be released in Japan in July and in Australia in December. It will sell in Japan for about $1000.

The sound that doesn't go round

There's a lot of talk that the compact disc is the digital audio disc system of the future. But Soundstream, the digital recording company, has developed a digital playback system where the software is in the form of a non-moving card.

The system, called the AudioFile, is based on a card the size of a conventional 125 x 75 mm index card and has the thickness of a credit card. The card will store up to 45 minutes of audio and can contain up to 600 M of digital data. For non-audio purposes such as video and computer software a larger card can be used.

Unlike the Compact Disc, which is injection moulded from a stamper, rather like a normal LP, the AudioFile is duplicated by a photographic process. This should make it more reliable and less expensive to produce than rotating discs.

The AudioFile also encodes the audio signal as a digital bit stream which is read by a low power laser beam, but the data is stored in a different manner from the CD system. The data is split into discrete traces which are then scanned, raster fashion, by a moving spot of light.

The data is written as a sequence of spots and spaces on the photographic medium in a series of discrete arcs. To read the data, rather than go in for the complicated servo and speed control of CD, a rotating disc with focusing microscope objective lens mounted on its periphery causes the laser beam to scan an arc on the card surface.

Using simple on-axis optics and clamping to ensure a flat record means that there is no need for a complicated focus servo mechanism.

As the working distance between the record and the scanning disc is so large the entire optical system can be sealed. This should increase reliability and could even reduce costs.

Another positive factor for the AudioFile is that the low cost of mastering/duplicating cards will make it viable for short production runs suitable for specialist musical interests.

Robust mic connectors

A range of robust multi-pin microphone plugs and sockets is offered by the Sydney-based importer and distributor, Benelec Pty Ltd.

The range comprises two in-line plugs, three in-line sockets, two panel mount sockets and a panel mount plug.

Straight and right angle in-line sockets in two-pin, three, four, five, six, seven and eight-pin versions are stocked along with a straight in-line plug in two- to eight-pin versions. A panel mount socket to suit these is also available. This group of connectors is listed in Benelec's catalogue from number 4-501 to 4-528.

In addition, a set of plugs and sockets that mate with Canon connectors is stocked. There is an in-line plug (4-561), an in-line socket (4-563), a panel mounting plug (4-562) and a panel mounting socket (4-564).

Benelec also carry a range of DIN connectors and 6.5 mm jacks.

For further details contact **Benelec Pty Ltd, P.O. Box 21, Bondi Beach NSW 2026. (02) 665-8211.**

Denon's dynamic servo tracer tonearm

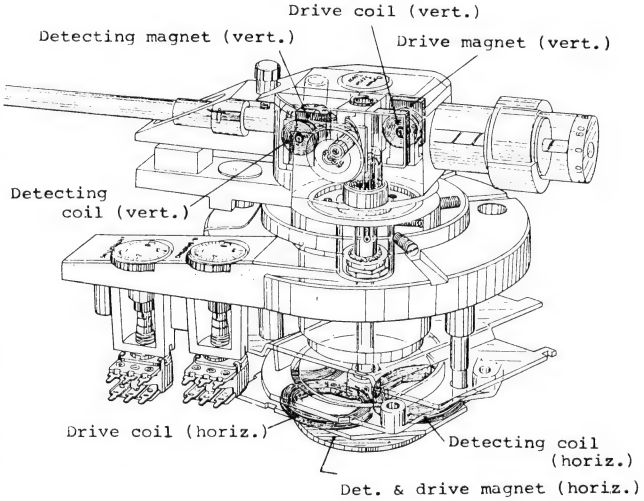
High compliance cartridges and lightweight tonearms help improve tracing, but Denon believe that their new dynamic servo tracer tonearm goes further to complete improvements in performance.

In conventional tonearms the low frequency resonance is a function of the compliance of the cartridge and the effective mass of the tonearm. If the level of this resonance is too high the results are IM distortion, an increase in crosstalk, excessive wear on both the stylus and record and damage to the stylus cantilever.

The dynamic servo tonearm features electronic damping in both the horizontal and vertical planes to minimise and control low frequency resonance. Denon claims that tracing is improved in even the most abnormal groove conditions, such as those found on hard-to-trace warped or off-centre records.

Originally designed for Denon's top-of-the-line DP-100M turntable, the dynamic servo tracer tonearm can now be found on several medium priced Denon turntables.

For more information contact **AWA-Thorn, 348 Victoria Rd, Rydalmere NSW 2116. (02) 638-9022.** ●



trim, taut and terrific

Mini & Slim

Here, at last, are the portable radio cassette recorders with the really big performance. Tough enough to handle, with sound reproduction you'd expect from a full size stereo.

See and hear one now at your nearest retailer...you may even take one home. But-that's life.

SANYO

That's Life!

M7880K

M7770K

M-W25F

M7000

M1600

Pioneer A-8 amp re-tested

The strange story of a schizoid amplifier and how Pioneer have a 'world beater' on their hands but haven't let the world know about it.

BACK IN JUNE last year we published Louis Challis' review of the Pioneer A-8 stereo amp. Louis said the A-8 had one major virtue: "... the quality of sound it can produce." Performance was very good at low and high power levels. THD at 1 kHz was 0.0036% (36 parts per million) and at 1 kHz/90 W it was 0.0018% (18 ppm). TIM was also very low.

Shortly after the review appeared we were contacted by Edward Cherry, Associate Professor from the Electrical Engineering Department of Monash University, Melbourne. He said he was surprised that the distortion was *so high* as Pioneer was employing his distortion-lowering technique of nested differentiating feedback loops (NDFLs), and paying royalties to do so.

As it turned out, that particular amplifier we measured did not incorporate Cherry's NDFLs. We subsequently obtained an A-8 through Monash University, purchased at a large Melbourne hi-fi retailer, and ran a second series of distortion tests.

We later learned that Pioneer produced two 'series' of the A-8, the latter series incorporating the NDFLs, the earlier series without. Pioneer's brochure on 'stereo amps and tuners A-9/A-8/A-7/A-6/A-5/F-9/F-7/F-5' has one paragraph mentioning nested feedback loops, crediting Associate Professor Cherry. According to Pioneer, the A-8, A-7, A-6 and A-5 all incorporate NDFLs or, as the Japanese prefer, NFLs.

Pioneer, to our knowledge, have not publicised the fact that their amplifiers employ the NDFL technique — either in the technical press or in the general media. The only mention we can find is in that one brochure. Pioneer — we think you should make more of it, plus its origin.

Further reading on the subject can be found in *Audio Amplifiers Using Nested Differentiating Feedback Loops*, ETI October and November 1982.

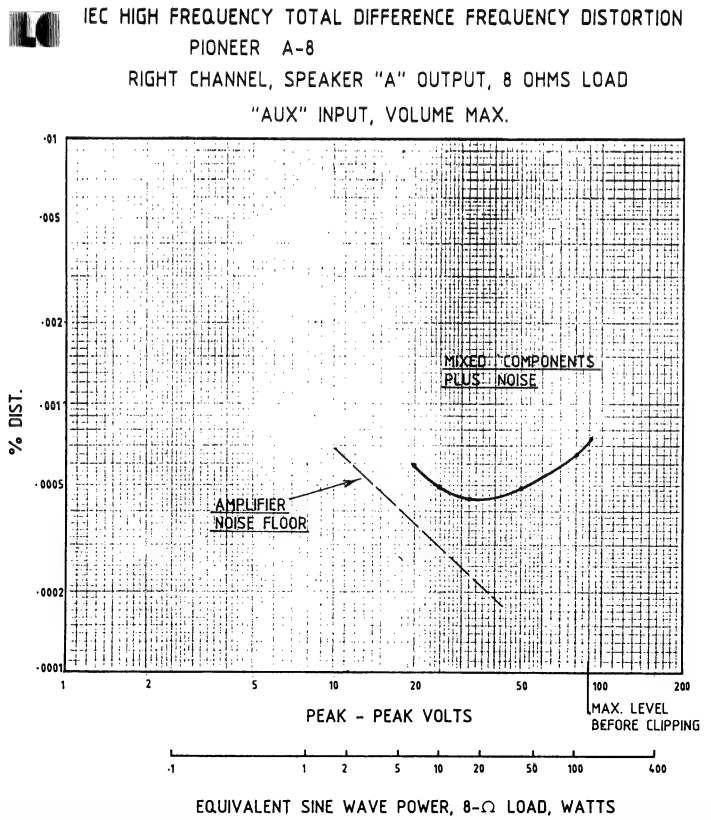
The re-test

As you can see, the latest version of the A-8 amplifier containing the NDFLs has distortion figures that are *an order of magnitude superior* when compared with the original version.

The distortion levels are so low that they really are at the threshold of our ability to measure them — (what do I do now if they develop better amplifiers?). Equally significantly the IEC High Frequency Total Difference Frequency distortion performance is also excellent, particularly at the higher power levels where the performance is almost half an order of magnitude better than the best amplifier we had previously seen (Marantz SM6 in class A mode, which was better at low power level).

The nested feedback circuit has converted what was an excellent amplifier, into what must now be described as a *superb amplifier*. Bravo Associate Professor Cherry! Bravo Pioneer! But why no fanfare? Don't they realise what they have produced? (Next marketing step will obviously be a class A amplifier with nested feedback circuit which will drive us right up the wall if my guess is not wrong.)

Louis A. Challis



MEASURED PERFORMANCE OF: PIONEER AMPLIFIER MODEL A-8
SERIAL NO. CC95011955

HARMONIC DISTORTION:

@ 1 watt into 8 ohms

	100Hz	1kHz	6.3kHz	
2nd	-100.6	-101	97.0	dB
3rd	-85.4	-	-	dB
4th	-107.3	-	-	dB
5th	-	-	-	dB
THD	0.0055	0.00089	0.0014	%

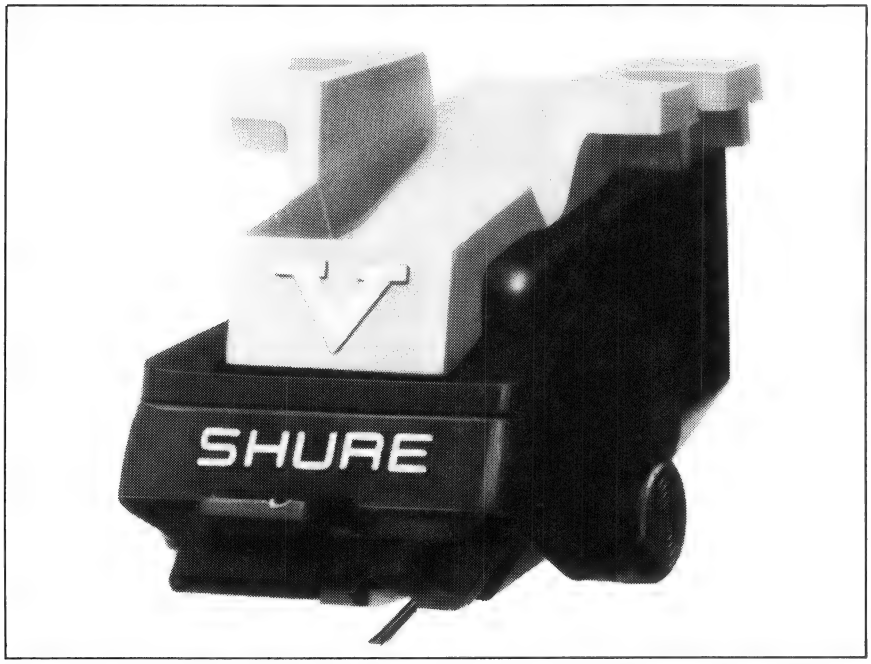
@ 90 watts into 8 ohms

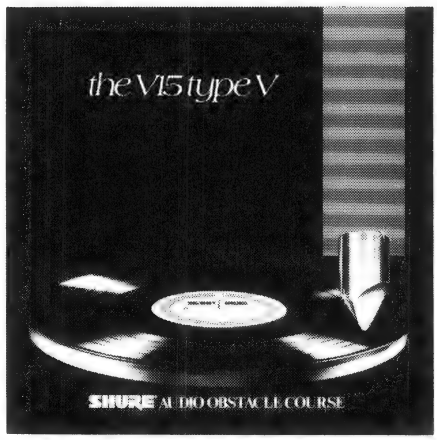
	100Hz	1kHz	6.3kHz	
2nd	-89.8	-111.7	-112.0	dB
3rd	-81.4	-105.2	-112.0	dB
4th	-116.9	-	117.0	dB
5th	-98.6	125.4	-	dB
THD	0.0092 (residual hum in amplifier)	0.0006	0.00038	%

LAC Generator and Analyser Threshold Distortion Values

	100Hz	1kHz	6.3kHz	
2nd	-116.4	-	-119.0	dB
3rd	-104.2	-122.8	-121.5	dB
4th	-	-	-	dB
5th	-	-	-	dB
THD	0.00063 (residual hum)	0.00007	0.00014	%

Shure V15 type V cartridge





Obstacle course. The Shure TTR117 test record, available from Audio Engineers, the Shure distributor.

Louis Challis

Exciting results. An absolutely stunning performance shows that the conventional microgroove record is still a force to be reckoned with. This excellent cartridge could not be improved upon with the current technology.

SHURE V15 TYPE V CARTRIDGE

Weight:	*6.6 g*
Price:	*Rrp $299*
Manufactured:	*In USA by Shure Bros, Illinois*
Distributor:	*Audio Engineers, 342 Kent St, Sydney NSW 2000 (02)29-6731.*

WHEN SHURE BROS decided to make cartridges for record players some thirty or more years ago it is doubtful whether they were aware of the impact they would have on the world of home entertainment. But now their industry is threatened by the new and exciting medium of laser discs. These digital discs may well change the future of the recording industry and in particular, the preferences as to which equipment will be used to play our music.

Notwithstanding any threat to the medium, Shure Bros and most of their competitors are actively engaged in developing new cartridges to overcome the performance limitations which are common to all record player cartridges. The areas for concern are, in order of importance, trackability, frequency response, frequency linearity, channel separation and signal-to-noise ratio, together with the one parameter that is seldom discussed in much detail by manufacturers, the life of the cartridge. The life of the cartridge depends on the ability of the stylus assembly to withstand abuse and also depends on the rate of wear on the stylus which is a function of the stylus configuration chosen.

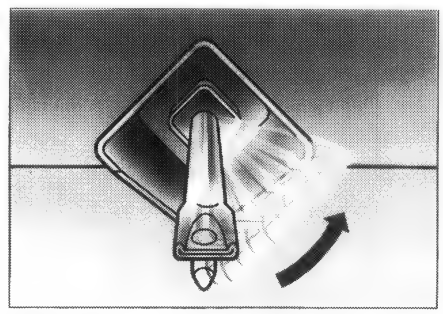
Most of the international reviewers who have spoken on this subject have stated that frequency response is the most important parameter in a phono cartridge. I just don't agree and both Shure Bros and I believe that the most important parameter is trackability. 'Trackability' is defined as the ability of the stylus to faithfully follow the path between the sides of the record player grooves. Shure Bros have stressed the trackability feature of their top line cartridges in their literature and ever since 1966 have presented in their 'Audio Obstacle Course' records what have been the industry standards for trackability tests. The release of the V15 type V is no exception to this rule and, for those people fortunate enough to purchase the new cartridge, the manufacturers provide a copy of their new record to assist in assessing the new cartridge's performance.

Features

The V15 type V, like all the other cartridges in the Shure range, is a moving magnet configuration with a hypereliptical nude diamond tip. This configuration is remarkably similar to that used for the now famous Shibata type CD4 tip. The hypereliptical stylus was selected because it produced significantly lower tracking distortion than either a conventional spherical tip or a biradial tip. The microwall stylus shank assembly has a diameter of only 0.04 mm and a wall thickness just a shade thicker than 0.01 mm.

Shure decided to use a thin walled beryllium stylus support arm which incorporates a much smaller diamond tip than any previous Shure cartridge. By using beryllium they achieve very high strength and very low weight. I consider that this is about as far as they can take the current technology and materials without thinking of developing some entirely new esoteric material. Obviously Shure are intent on decreasing the effective moving mass of the cartridge and claim that they have achieved a 40% reduction compared with the type IV model.

The benefits of such a change are obvious. Firstly, they have been able to shift the stylus tip resonance from approximately 22 kHz to almost 33 kHz. This allows them to achieve a flat frequency response within the desired 20 Hz to 20 kHz audio band. More



Side-guard. This illustration shows how Shure s 'side-guard' system responds to side thrusts on the stylus by withdrawing the entire stylus shank and tip safely into the stylus housing before the shank can be damaged.

importantly, with a lower mass in the stylus assembly, the ability to cope with higher tracking velocities in the latest generation of digital and 'direct to disc' recordings is now a reality.

Shure claim that the new type V cartridge can track signals at speeds of up to 80 cm/s at 5 kHz and as our measurements have shown, the velocity levels are almost this high in the majority of the best (and most expensive) recordings now being produced in America and Europe.

The cartridge incorporates a number of other features which are designed to protect the cartridge against abuse. The most significant of these features is the 'side guard' stylus assembly which enables the entire assembly and tip to be withdrawn into the housing when exposed to a significant sideways thrust. It also incorporates a 'dynamic stabiliser' which consists of a damped carbon fibre filter brush. This brush, which precedes the stylus on its path around the record, is intended to reduce the effect of the tone arm resonance and simultaneously improves the tone arm's tracking over warped records. This brush also cleans out the dust and debris which may lurk in front of the unsuspecting stylus.

In keeping with the latest research work undertaken in their laboratories, Shure have introduced a new jargon or 'buzz word' which they call the 'Total Trackability Index' (TTI). They define this as the trackability factor x the indentation factor. The theory behind this system is described on the associated TTR 117 record cover jacket.

The indentation factor is defined as the relationship between tracking force, the tip geometry and the amount of record wear. Obviously the vinyl or plastic based records deform (indent) as a result of the passage of the stylus through the groove of the record. Provided the indentation is not too severe, the vinyl will go through a plastic mode of deformation, with the extent of restoration being a function of the force applied to the surface of the groove. Different stylii tip characteristics have different areas of contact and so the tracking force is obviously a function of the surface area of the tip which makes contact with the record grooves. The rate of wear of these grooves is a direct function of the indentation depth and is consequently a function of the velocity and the exposed surface area of the stylus tip. The latest generation of hypereliptical nude tips provides a 25% to 26% improvement in performance over a typical spherical stylus. This means that the record played by this stylus will suffer 26% less wear than that produced by a spherical tip.

Aligning the cartridge

The cartridge arrived in an unusual plastic box which I soon discovered doubles as an alignment gauge. They have attached a dummy stylus assembly to the gauge so that you will not damage your new toy as you enthusiastically position it correctly in the tone arm. The alignment gauge is provided to allow you to check whether your head shell is parallel to the record surface. This is absolutely essential if proper stereo separation is to be achieved. The box also incorporates a series of small plastic self-adhesive shims to allow the cartridge to be tilted and adjusted where rotational geometry is not provided as part of the head shell or tone arm assembly.

A second alignment gauge is provided which allows you to align the cartridge for minimum lateral tracking distortion. By adjusting the cartridge to have the correct overhang, the minimum overall distortion can readily be achieved. This particular alignment gauge is called the duo-point alignment gauge and adjusts the cartridge at the correct distances of 66 mm and 120.7 mm from the record centre.

Each cartridge is supplied with its own individual calibration sheet. This provides specified levels of output at 5 cm/s, the channel balance parameters, channel separation at both 1 kHz and 10 kHz, the trackability at 400 Hz and both left and right channel frequency responses.

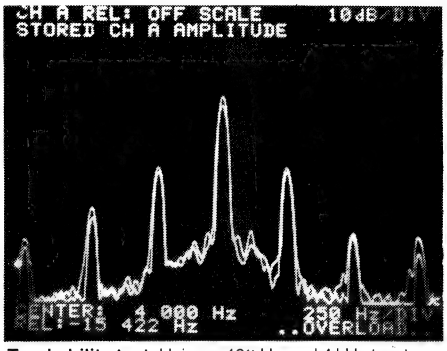
It is interesting to note that the V15 type V sold in the United Kingdom is not supplied with as much comprehensive information as those sold in Australia. I presume that the Americans either believe that the Australians are a more sophisticated market or they require more technical information than their United Kingdom counterparts.

Precision alignment. To ensure that the V15 type V cartridge's performance is optimised by accurate orientation in the tone arm, precision alignment instrumentation is provided with each cartridge. This includes the Shure-designed Duo-Point Alignment Gauge (left) and Leveling Alignment Stylus (right) which simplify accurate alignment. The Duo-Point gauge accurately establishes correct lateral tracking geometry for minimum distortion during playback. The Leveling Alignment Stylus aids in optimising channel separation by providing a means with which to judge cartridge body orientation relative to the record surface.

Test conditions

I asked the local agents if they wanted to supply the cartridge in one of the latest SME arms, which have in the past been the preferred and favoured tone arm assembly recommended by Shure Bros. The local agent assured me that the V15 type V will work in *any* tone arm and would make it perform better than it would with any other cartridge. Taking the agent at his word, I decided to avail myself of the opportunity to assess the V15 type V in the Audio-Technica type AT1010 DTS Universal Tone Arm. This particular tone arm is a j-shaped aluminium unit with an effective length of 241.3 mm from the pivot to the turntable centre and it is mounted with a gymbal based on precision ball bearings. The head shell is machined from die-cast magnesium alloy which is covered by a rubber solution to damp out resonance modes. The tone arm tube is mounted above vertical pivots so that the stylus of the cartridge will be positioned in the plane of the pivots when playing the record. This minimises warp, wow and changes in the vertical stylus angle.

The counter weight at the far end of the tone arm incorporates the tracking force scale calibrated from 0 to 2.5 g in 0.1 intervals and the rear of the arm is vibrationally isolated with rubber from the front portion. The suspended mass can thus supply anti-resonant compensation for the main low frequency resonance between the total ▶



Trackability test. Using a 400 Hz and 4 kHz two tone test signal on the Shure TTR 103 test record. The graph shows the difference between the distortion components at the peak tracking signal on the record when superimposed on the base level. The velocity was recorded at 15 cm/s and 24 cm/s on two tracks.

effective arm, cartridge mass and the compliance provided by the cantilever mounts. A small knob on the top of the arm pivot provides adjustable damping so as to vary the stiffness of the elastic coupling between the two sections of the tube. On one side of this arm is a balance weight to compensate for lateral imbalance. This is supplemented by a gyro balance weight that can be shifted vertically to compensate for the vertical period of swing of the tone arm. The effective arm mass, without the cartridge, is about 18 g which is not low but it does provide a reasonable degree of stability in the system.

I mounted the V15 type V cartridge and the tone arm on the Luxman PD444 direct drive turntable which allows two tone arms and cartridges to be evaluated simultaneously on the same record in the measurement set up.

Testing

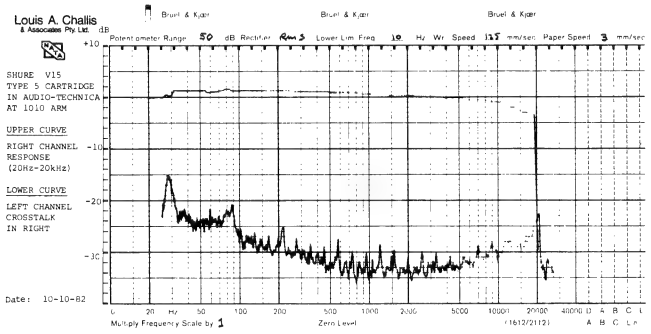
The testing sequence that followed provided a great deal of information on the performance that this cartridge can achieve when correctly mounted in a good tone arm. The testing also provided a great deal of information on the tone arm itself.

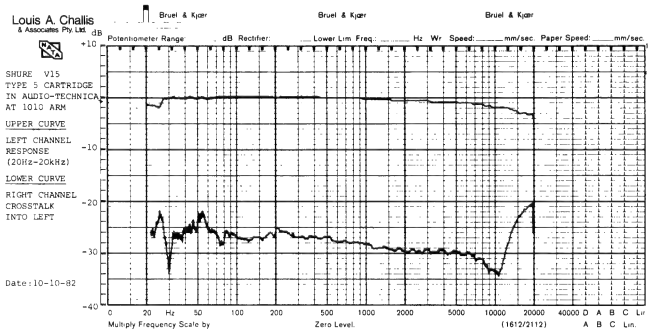
The frequency response of the V15 type V is typically +0−2 dB from 20 Hz to 10 kHz with a very smooth frequency response that is less than 3 dB down at 20 kHz. The channel separation is typically 35 dB at midband in the left channel and better than 30 dB in the right channel when measured on either the JVC TRS 1007 or the Bruel & Kjaer 2009 test records. These figures are just about the records' limits so that the indicated results are very good. The frequency response is only 6 dB down at 35 kHz, when measured on the Denon XG-7002 test record, which is an exceptionally good performance. The indicated cartridge resonance utilising the same test record lies between 30 and 33 kHz which is also excellent. I tested the cartridge with a 1.25 g tracking weight and found that the cartridge would happily track with just the slightest suggestion of distortion at a velocity of 24 cm/s at 400 Hz with a superimposed 4 kHz test tone.

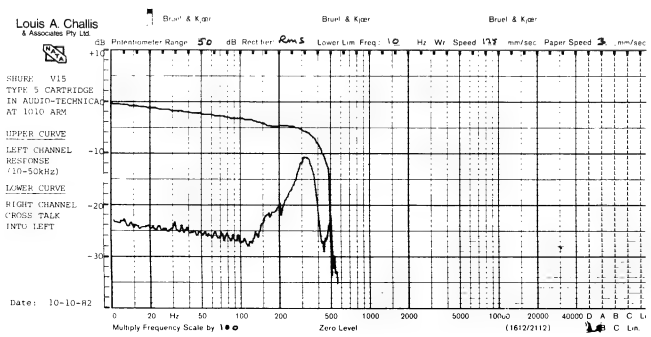
Other audio test records which I used are the Shure TTR 103 and TTR 109, Audio Technica AT 6605 and JVC 1005. Surprisingly Shure do not provide trackability signals in any of their standard test records at the 80 cm/s velocity level that they refer to. So on the straight objective testing, using the material I currently have available such as the orchestral bells and other test signal material, we measured velocities up to 60 cm/s. The conventional test material, especially the two tone test records, provide very good evaluation material for objective tests.

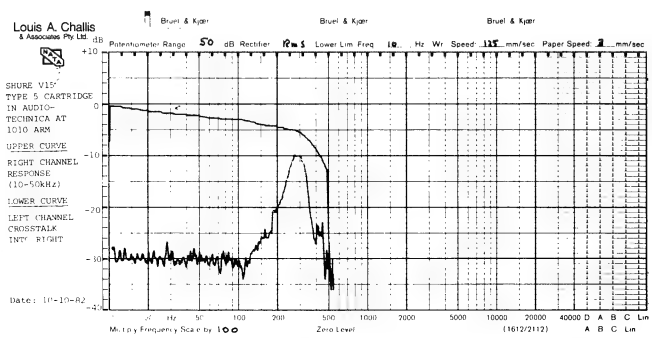
I spent a lot of time analysing these signals on our fast Fourier analyser and although I was able to measure distortion levels and transient intermodulation signals all the way up to 40 cm/s, the cartridge nonetheless has what I would classify as very satisfactory tracking and excellent trackability performance.

Another factor of equal interest is the effect of the dynamic stabiliser on the tone









arm resonance. This is displayed particularly well in the graph below. This shows a 7 dB drop in the resonance peak of the tone arm at 5.5 Hz which is altered to a new resonant peak at 6.5 Hz when the stabiliser brush is used during the resonance playback evaluation. The overall maximum rise at 6.5 Hz, compared with the 20 Hz signal, is only 7 dB. I measured the distortion with and without the stabiliser in use and found that the distortion level rises by a small but measurable amount when the stabiliser is used. The stabiliser thus has a number of attributes and one liability!

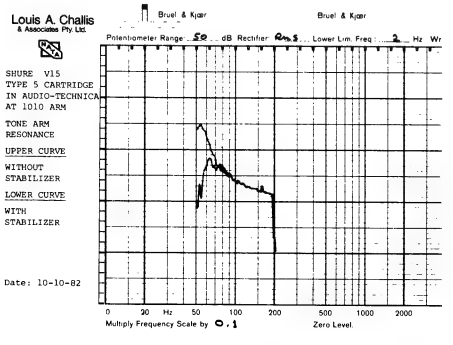
Subjectively

Of course the question is 'how does it perform on *real material*'? The first record I chose for the subjective evaluation was a Sony CBS DR Master Sound Digital Recording 28AC703 with Hiroko Nakamura playing selected pieces from Greig. By a strange quirk of circumstances I received the first laser disc player to reach Australia with exactly the same pieces of music digitally recorded on disc.

Without pre-empting that review I was able to compare the performance of the Shure V15 type V cartridge with the same material replayed digitally. The results were exciting because the V15 type V cartridge performs exceptionally well and shows that the conventional microgroove record is still a force to be reckoned with. The piano playing projected a superlative quality with depth, colour, vitality and warmth being fully displayed.

The second record I chose to play was the Sheffield Track Record (lab 20) which does contain really nasty peak velocities exceeding 70 cm/s at midband and low frequency velocities well above 30 cm/s. The cartridge seemed to revel in its role and I enjoyed listening to the music which it produced. The V15 provides an absolutely stunning performance and is undoubtedly a worthy successor to the V15 type IV.

All in all the V15 type V is an excellent cartridge highlighting a situation in which the designers have now reached the top of the development curve, with no new technology and few new avenues available to them to improve what is already a fine product. ●



MEASURED PERFORMANCE OF
SHURE V15 TYPE V CARTRIDGE

SERIAL NO: 007027

SENSITIVITY:
Right Channel 0.64 mV/cm/sec
Left Channel 0.62 mV/cm/sec

CROSSTALK:

	100Hz	1KHz	6.3KHz	
Left into Right	- 28	- 35	- 32	dB
Right into Left	- 27	- 28	- 29	dB

Left into Right minimum @ 28KHz 5dB
Right into Left minimum @ 32KHz 5dB

TONE ARM RESONANCE:
5.5 Hz (see attached graph)

FREQUENCY RESPONSE
20 Hz *to* 35 KHz (see attached graphs)
(allowing for arm cable capacity)

HARMONIC DISTORTION

Left Channel		50Hz		1KHz		6.3KHz		
	Stabiliser	With	Without	With	Without	With	Without	
	2nd	-52.0	-53.9	-43.7	-42.9	-33.5	-29.2	dB
(1st Column using stabilizer with tracking weight to suit)	3rd	-55.6	-56.1	-47.8	-49.0	-45.7	-39.6	dB
	4th	-	-	-55.6	-	-44.0	-37.4	dB
	5th	-	-	-	-	-	-	dB
	THD	0.3	0.25	0.71	0.80	2.7	3.8%	

Right Channel		50Hz		1KHz		6.3KHz		
	Stabiliser	With	Without	With	Without	With	Without	
	2nd	-46.9	-49.8	-29.5	-32.3	-31.2	-31.1	dB
(1st Column using stabilizer with tracking weight to suit)	3rd	-53.5	-54/1	-33.9	-35.3	-28.4	-33.1	dB
	4th	-56.3	-	-42.3	-41.2	-34.5	-42.6	dB
	5th	-	-	-48.7	-49.5	-	-	dB
	THD	0.52	0.38	4.0	3.1	5.1	3.6%	

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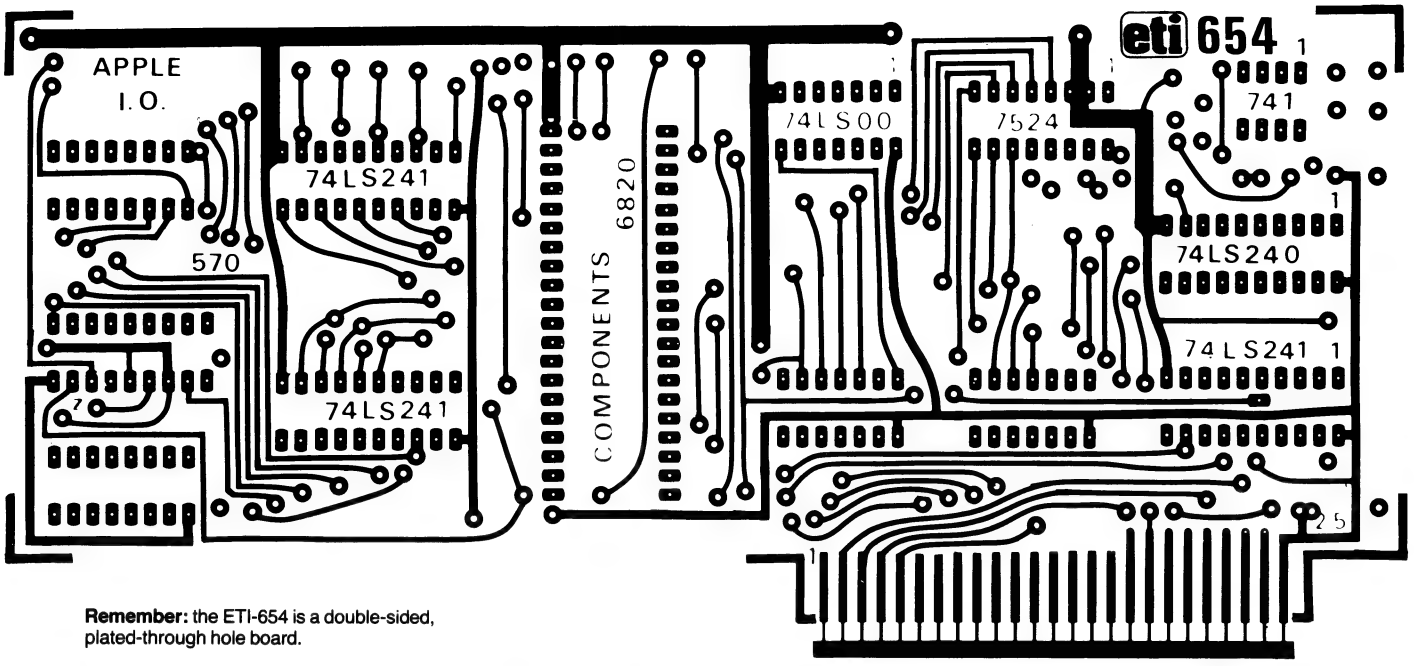
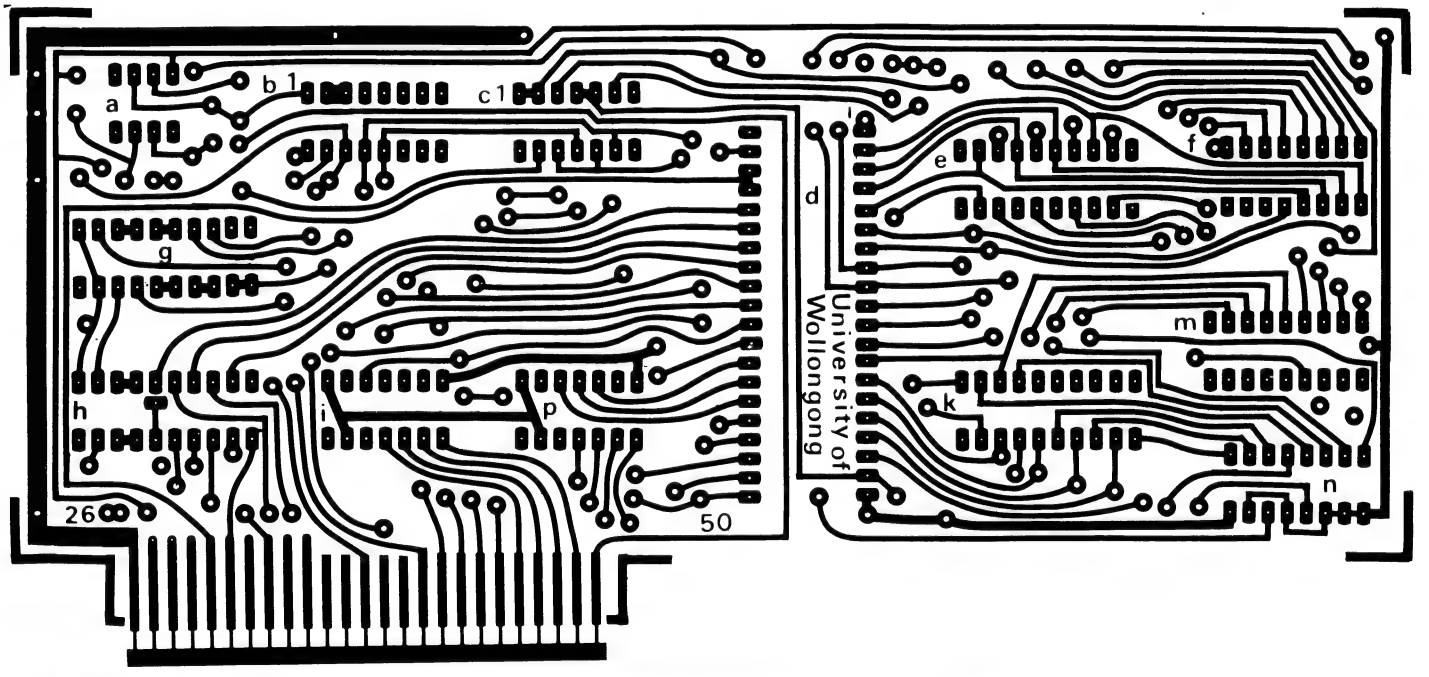
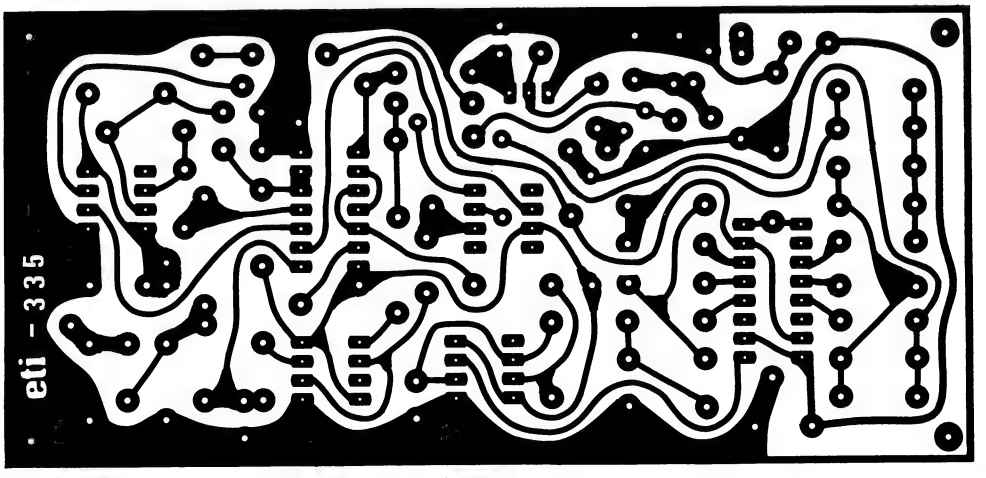
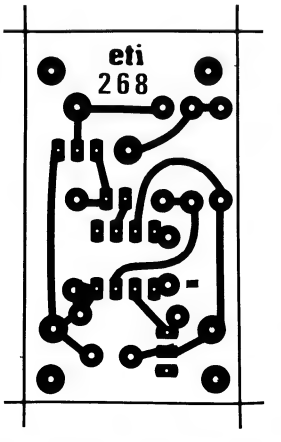


Remember: the ETI-654 is a double-sided, plated-through hole board.







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SELL: KEYBOARD INSTRUMENT, Kimber-Allen SKA. Best available. Factory mounted with pads, springs, silver contacts and wipers, 37 keys. Unopened. Half price at $170. (03)29-1820.

COMMUNICATIONS

SIGNAL GENERATOR MARCONI TF801A/1, AM/CW, 10 to 310 MHz, output calibrated attenuator range 100 dB in 1 dB steps, 0.2 V to 2 uV, fully metered, brand new with handbook, $250. VK2ASZ, (047)39-4109.

APX6 1296 MHz trscvr with 240 V P/S-audio unit, $40. Copies of conversion articles for APX6 trscvrs, 20 pages, $9. VK2ASZ, (047)39-4109.

FOR SALE: COLLINS 32RS1 H/F SSB 100 W base station Trcvr, 240 Vac, $400. VK2ASZ, (047)39-4109.

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DISK DRIVES, dual 8" DS DD REMEX 4001 with power supply, $1100 ono. Two 5¼" MPI 92 quad density DS drives, $475 ono. Ring between 6.30 and 9.30 pm (051)34-7836. Morwell Vic.

Z80 STARTERS KIT by SD Systems. Fully expanded, 2K RAM, 4K ROM, Hex keypad and display, cassette interface and S100 expansion. Full documentation, $250. G. Bond, Potts Rd, Cranbourne Sth Vic. 3977. (059)78-2613.

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MEMORY FOR Motorola Exorciser Buss, 8K RAM, (2114), $60 ono. 16K RAM (2114), $90 ono. Ring between 7 pm and 9.30 pm (051)34-7836. Morwell Vic.

ZX81, 16K, books, manual, tapes, games cassette player. Complete $265. Consider swap for pocket computer. (065)83-2679 ah. Ask for Michael.

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SELL: SINGLE BOARD 6502 computer, 48K RAM plus BASIC, full keyboard, graphics etc, $450. (09)401-4652 ah.

OSI SUPERBOARD II, 8K RAM, power supply, monitor and full documentation. Two BASIC games books. Must sell, $400. Dane Howe (03)350-1646.

MICROBEE 16K software, Adventure #1 and Astrofighter (action space game). $9.95 each + $1.50 postage. J. Burns, 6 Banksia St, Townsville Qld 4814.

SUPER 80, 48K RAM, character gen, EPROM BASIC, custom metal case, power supply mains filter, $300. Phone Newcastle (049)82-8606.

SELL: CRAIG M100 translator, six modules included, only $115. All in A1 cond. Cost over $200. Contact Paul, 586 William St, Mt Lawley WA 6050.

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SELL: Z80, S100 microcomputer. Includes DGZ80 CPU, DG640 VDU, expandoRAM with 32KB, power supply, keyboard, monitor and lots of software, $650. Gordon (02)587-3449.

MICROBEE FINANCIAL MANAGER: a cheque account program with account file SAVE/LOAD. Instructions, listing (8 pages) $8. With tape $13. H. Proctor, 27 Roberts Avenue, Mortdale NSW 2223.

HOBBY COMPUTER: 2650 CPU, 16K RAM, dual VDU, built-in cas. rec, 110/300/3000 baud, I/O ports, RS232, video and RF outputs, assembler, BASIC, software, CCT diagrams etc. $225. (08)336-4114.

A MICROBEE OWNERS club would be a great idea. If you can't find a club or you are interested in starting one send a SSAE envelope to Colin Johns, 6 Tunks St, Waverton NSW 2060 and I will send you the latest information.

FLOPPY DRIVE: Brand new, unused 8 inch 2S2D Remex RFD4000 and full maintenance manual. Sell $570. Craig, 110 Greeves St, Fitzroy Vic. 3065. (03)341-8549 bh.

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SELL: SCALEXTRIC SLOTCAR set, 13 m track, two cars, electric transformer, excellent condition, $150 ono. Use with ETI-824/825 controllers. Robert Roseby, 46 Ham St, Cloncurry Qld 4824.

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FOR SALE: ONE 65 metre length of heavy duty, 25 core, multi strand cable, $65. (02)456-1604 after 6 pm or (02)239-9472 bh.

SELL: TTY MODEL 15, good condition, with SC/MP microcomputer and ASCII baudot converter. SC/MP and TTY manuals included, $70. (07)208-7247. Slacks Creek Qld.

WANTED: INTERNATIONAL correspondence school, electronics course, Phase One texts, notes etc, complete or incomplete. Will pick up anywhere in Sydney. (02)709-1746.

WANTED: CIRCUIT DIAGRAM/manual for Simpson model 312 VTVM. G.J. Hill, 64 Robe St, Grange, Brisbane Qld 4051. (07)356-7727 ah.

SELL: ONE HOBBY-BLOX IC starter pack (Part No. 921490-R). Good condition, $15. B. Begg, 18 Sturt Ave, Toorak Gdns SA 5065.

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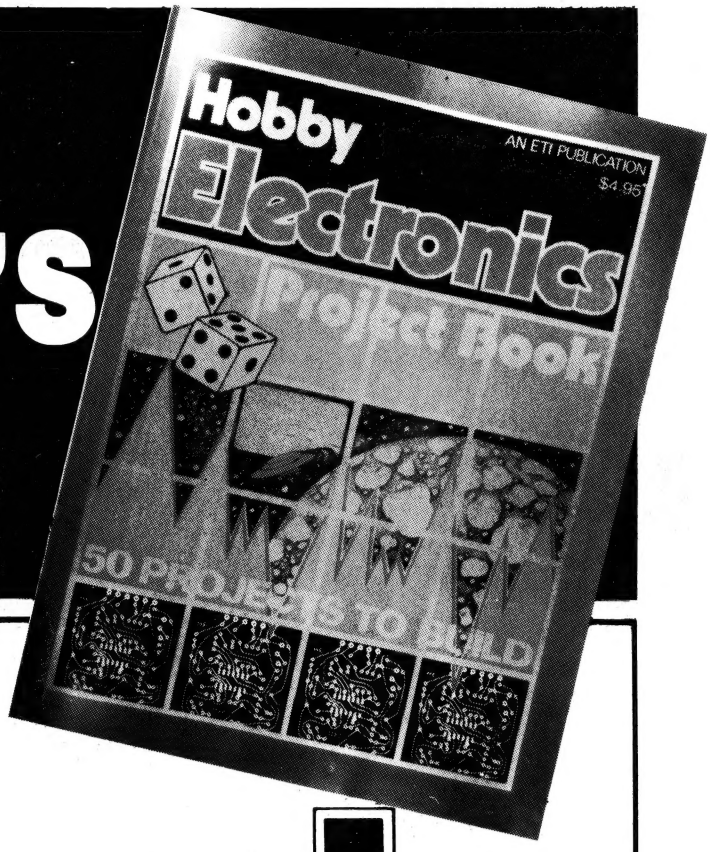

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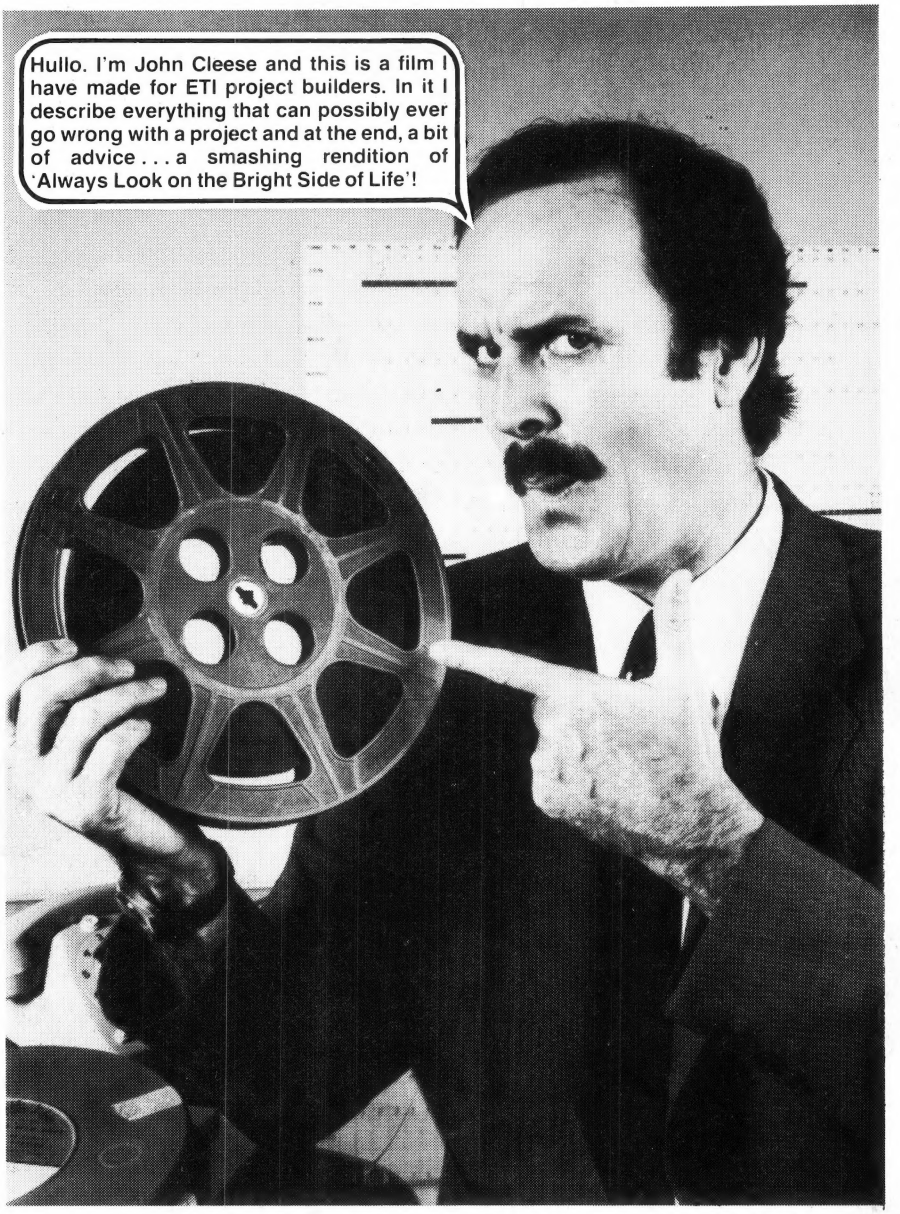
DREGS



It was just so embarrassing

Life is never dull, especially when there's a party on. And if you're in the mood for people-watching at parties you'll find that it's becoming an even more interesting occupation now.

Eager young man, smoking and drinking, has checked out all the chicks and is making his move. He starts to chat her up but has all his hopes shattered when he hears the strains of that golden-oldie, Smoke Gets In Your Eyes, coming from her direction. Just a bit off-putting. Her pendant is giving him a message. He's standing too close and blowing smoke in her face.

Jewellery is no longer only a decorative accessory to the rest of one's outfit, an expensive and pretty item to show off. It can also be practical with a message, thanks to US designer Mary Ann Scherr. Although undoubtedly the embarrassed ones who have been caught out won't be too impressed with her designs.

She makes necklaces, belts and bracelets that double as smoke sensors or bad breath detectors, warn of bad posture and sagging stomachs, let you know how much you fancy that attractive man in the corner and even let you know when you are about to nod off.

Mary Ann's pendant contains a smoke sensor and a music box which, at the first hint of any kind of smoke, gives you a few bars of the song Smoke Gets In Your Eyes. Not the sort of thing you'd want to have around if you were lighting up in a dark corner.

But things could be worse. The eager young man has passed the first test and is doing quite well. He's bending low over the lovely young lady, looks deep into her eyes, his lips almost touching hers and then her necklace starts blinking bright red. It's telling her (and him) he stinks of alcohol, onions, garlic or just plain bad breath.

Then there's the fancy-scrolled silver bracelet that buzzes when your heart starts to race and your pulse gets more rapid when that special man you've had your eye on all night makes an obvious move in your direction. This one is for those people who didn't know that they were excited.

For people with poor posture, Mary Ann has come up with a belt that gives off an electronic signal whenever your stomach starts to sag. That could be quite a shock for some people.

The 'no-nod' device is attached to a pair of glasses or a headband and a beeper goes off when the wearer's head starts to nod down towards his chest. I suppose explaining the 'beep' at a boring dinner party could be less embarrassing than apologising for falling asleep at the table.

This particular device was originally designed for children suffering from cerebral palsy to signal them to keep their heads up. And now the military brass at the Pentagon are interested in it. They feel that a special headset, with a special built-in 'no-nod' capability, would be just the thing for sentries on duty at missile bases.

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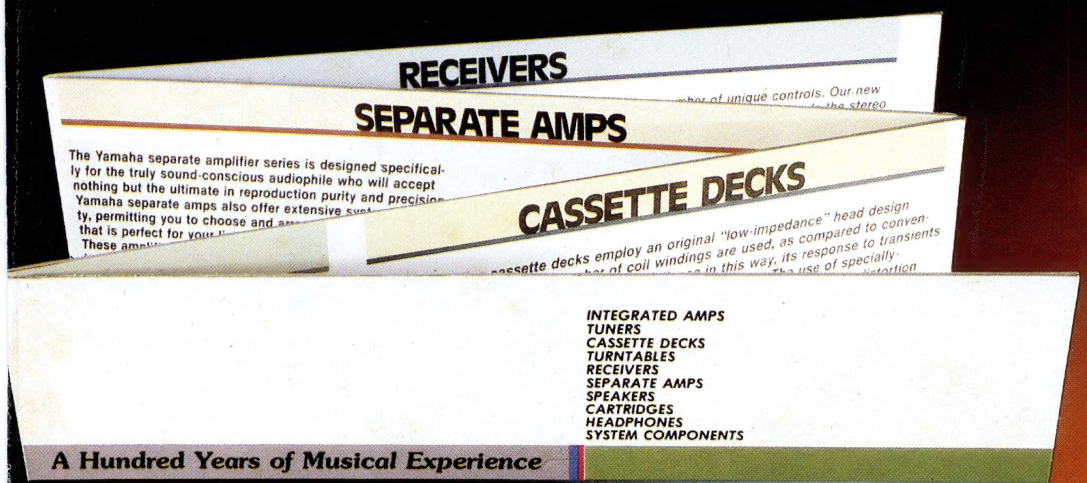

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